

## ภาคผนวก (ง)

## ตัวอย่างข้อมูลผลการทดลอง



ศูนย์เครื่องมือวิทยาศาสตร์ มหาวิทยาลัยสงขลานครินทร์  
 ชั้น 1 อาคารบริหารวิชาการรวม มหาวิทยาลัยสงขลานครินทร์ วิทยาเขตหาดใหญ่ อำเภอหาดใหญ่ จังหวัดสงขลา 90110  
 Scientific Equipment Center, Prince of Songkla University  
 Central Academic Administrator Bld. Hat-Yai Campus, Songkhla 90110 Tel.0 7428 6904-7 Fax.0 7421 2813

F-RES-003/ME Rev.3 01/11/45

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## ANALYTICAL REPORT

Client Name and Address : Mr. Santi Rattanaviranon  
 Department of Physics, Faculty of Science, PSU.

Test Request Form No. : 3379/46

Test item(s) received date : March 24, 2003

Test performed date : March 27, 2003

Test Method used : Refer to WI-RES-XRF-001 and WI-RES-XRF-002

Analytical Instrument : X-ray fluorescence spectrometer (PHILIPS, PW2400)

Analytical Technique : X-ray fluorescence spectrometry

Analytical Condition : X-ray tube : Rh tube X-ray path : Vacuum  
 Application : GPsEmIQ Sample preparation : Pressed powder  
 Scanning range : From O to U  
 Objective : Semiquantitative measurement

Test item(s) description : Husk Quantity : 1 sample

Test Result :

Sample : Original rice husk

Compound	concentration (%)
MgO	0.26
Al <sub>2</sub> O <sub>3</sub>	0.28
SiO <sub>2</sub>	21.72
P <sub>2</sub> O <sub>5</sub>	0.31
SO <sub>3</sub>	0.25
K <sub>2</sub> O	1.22
CaO	0.61
Fe <sub>2</sub> O <sub>3</sub>	0.29

\* Trace element : Ti Cr Mn Ni Cu

\* Data file was kept in folder c:\customer\46\3379

(Miss. Patchara Sukonrat)

Analyst

(Mr. Terdnon Dumrongrittamatt)

Inspector



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No. 2774/46 Page 1/1

**ANALYTICAL REPORT**

**Client Name and Address :** Mr. Santi Rattanaviranon  
 Dept of Physics, Faculty of Science, PSU

**Test Request Form No:** 3791/46

**Test item(s) received date :** August 4, 2003

**Test performed date :** August 4, 2003

**Test Method used :** Refer to WI-RES-XRD-001

**Analytical Instrument :** X-ray Diffractometer (PHILIPS: X'Pert MPD)

**Analytical Technique :** X-ray tube : Co tube      Sample preparation : Pressed Powder

**Analytical Condition :** Objective : phase identification      Scan Program : geo

**Test item(s) description :** Rice Husk      Quantity : 3 sample(s)

**Test Result :**

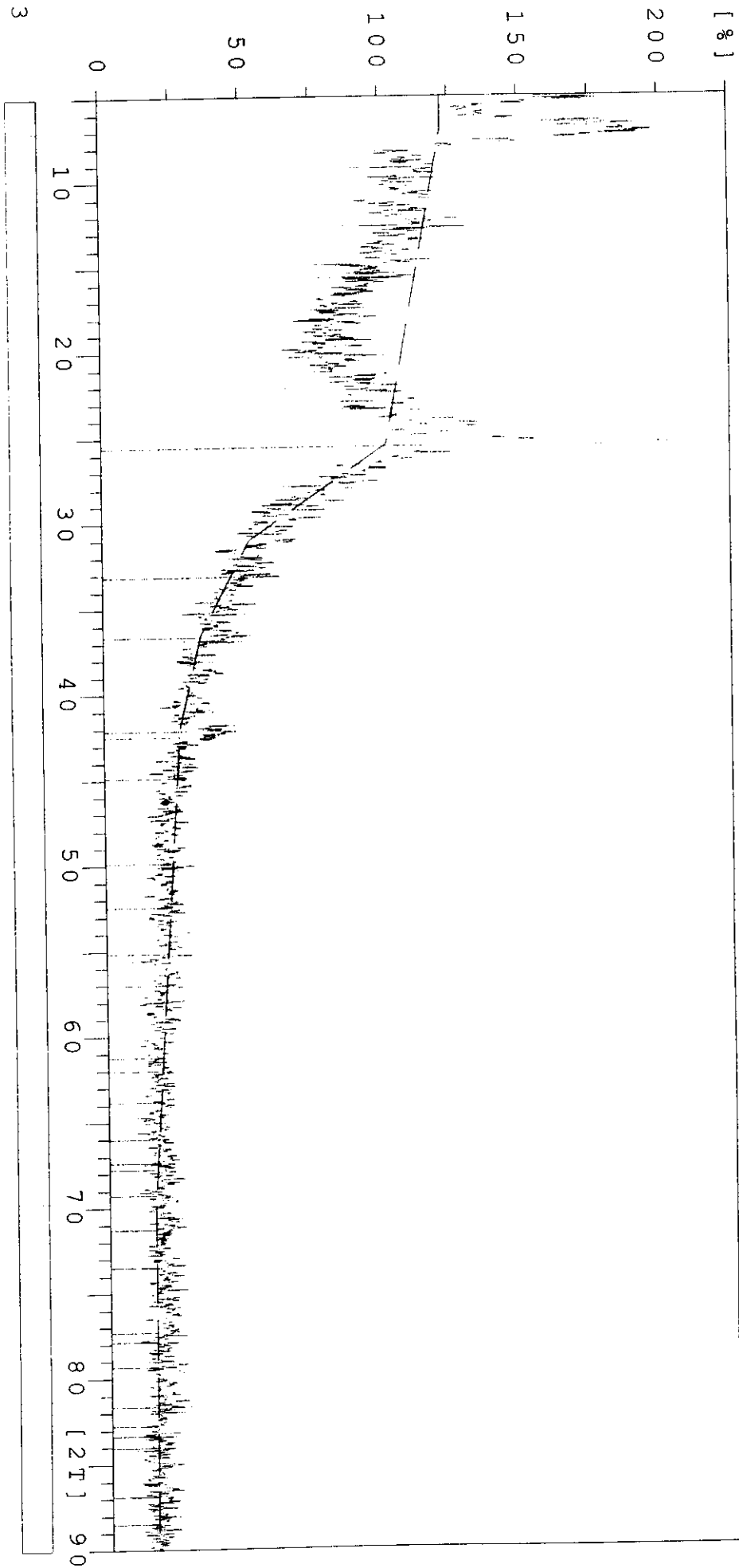
Code	Sample Name	JCPDF No.	Chemical Formula
3791-1	RHA 700 °C for 3 h.	-	Amorphous like diffractogram.
3791-2	RHA 800 °C for 3 h.	-	Amorphous like diffractogram.
3791-3	RHA 900 °C for 3 h.	22-0026	SiO <sub>2</sub> (Cristobalite)

As shown in attached sheets and refer to /3791 Santi

(Mr.Terdtoon Dumrongrittamatt)  
 Analyst

(Mr.Terdtoon Dumrongrittamatt)  
 Inspector

**Remark** This analytical report is valid only for the tested sample and raw data of result(s) will be saved at least a month.  
 This test report shall not be reproduced except in full, without written approval of the laboratory.



3791-3

04-0379 Cristobalite

SI02

C:\APDW\DATA\3791-3.DI

4-aug-1999 15:33

ific Equipment Center

Prince of Songkla University

114

D I F F I L E :

Sample identification: 3791-3

DI file name: 3791-3.DI

Input file name: 3791-3

Start angle [ $^{\circ}2\theta$ ]: 5.025End angle [ $^{\circ}2\theta$ ]: 89.975Start d-value [ $\text{\AA}$ ]: 20.40452End d-value [ $\text{\AA}$ ]: 1.26526

Maximum number of counts: 128

Anode material: Co

a1 Wavelength [ $\text{\AA}$ ]: 1.78896a2 Wavelength [ $\text{\AA}$ ]: 1.79285

Intensities for FIXED slit

Peak positions defined by: Minimum of 2nd derivative of peak

Minimum peak tip width: 0.00

Maximum peak tip width: 1.00

Maximum peak base width: 2.00

Minimum significance: 0.75

Number of peaks: 6

D I F F R A C T I O N L I N E S :

2 $\theta$	d-value a1 [ $\text{\AA}$ ]	d-value a2 [ $\text{\AA}$ ]	T.width [ $^{\circ}2\theta$ ]	Height [counts]	Backgr. [counts]	Rel.int. [%]	Signific
20	14.61026	14.64203	1.000	81	156	63.4	3.34
45	4.06159	4.07042	0.250	128	130	100.0	1.42
35	3.34344	3.35071	0.300	10	67	8.0	0.82
65	2.85892	2.86513	0.600	12	45	9.1	0.92
05	2.49570	2.50113	0.800	13	35	10.1	2.25
80	1.56573	1.56913	0.600	6	21	4.5	0.87

0379		Wavelength= 1.5405									
		d Å	Int	h	k	l	d Å	Int	h	k	l
SiO <sub>2</sub>											
Silicon Oxide		4.0400	100	1	0	1	1.2240	<1	4	0	1
		3.1380	12	1	1	1	1.2070	1	4	1	0
		2.8450	14	1	0	2	1.1842	2	3	2	3
Stobalite		2.4890	18	2	0	0	1.1762	1	2	1	5
		2.4680	6	1	1	2	1.1659	1	3	1	4
CuKα <sub>1</sub> 1.5405 Filter: Ni BetaM d-sp:		2.3420	21	2	0	1	1.1556	<1	3	3	1
I/cor:		2.1210	4	2	1	1	1.1112	1	3	3	2
Nat. Bur. Stand. (U.S.), Circ. 539, 1, 39 (1953)		2.0240	3	2	0	2	1.0989	3	4	2	1
		1.9320	4	1	1	3					
		1.8740	4	2	1	2					
		1.7560	1	2	2	0					
Tetragonal S.G.: P4 <sub>1</sub> 2 <sub>1</sub> 2 (92)		1.7360	1	0	0	4					
a: 3.573 b: 6.95 c: 6.95 A: C: 1.3975		1.6920	3	2	0	3					
β: γ: Z: 4 mp:		1.6420	1	1	0	4					
		1.6120	5	3	0	1					
Ibid.		1.6040	2	2	1	3					
		1.5740	1	3	1	0					
		1.5350	2	3	1	1					
Dm: SS/FOM <sub>3</sub> (=16(.049, 39))		1.4950	3	3	0	2					
2.322		1.4320	2	3	1	2					
1.484		1.4230	1	2	0	4					
Ibid.		1.4010	1	2	2	3					
		1.3680	1	2	1	4					
		1.3530	1	3	2	1					
		1.3450	1	3	0	3					
		1.3360	1	1	0	5					
Pattern taken at 27 C. Very pure SiO <sub>2</sub> prepared by RCA Laboratories. PSC: 112. Deleted by NBS Set 11. Mwt: 60.08.		1.3010	2	3	1	3					
Volume[CD]: 171.88.		1.2820	2	3	2	2					
		1.2350	<1	2	2	4					



### ANALYTICAL REPORT

**Client Name and Address :** Mr. Santi Rattanaviranon  
 Department of Physics, Faculty of Science, Prince of Songkla University

**Test Request Form No:** 4199/47

**Test item(s) received date :** January 8 , 2004

**Test performed date :** January 10 , 2004

**Test Method used :** Refer to WI-RES-XRD-001

**Analytical Instrument :** X-ray Diffractometer (PHILIPS: X'Pert MPD)

**Analytical Technique :** X-ray tube : Co tube Sample preparation : Pressed Powder

**Analytical Condition :** Objective : phase identification Scan Program : geo

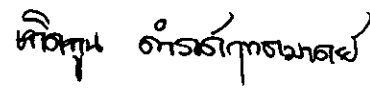
**Test item(s) description :** Rice Husk Quantity : 1 sample(s)

**Test Result :**

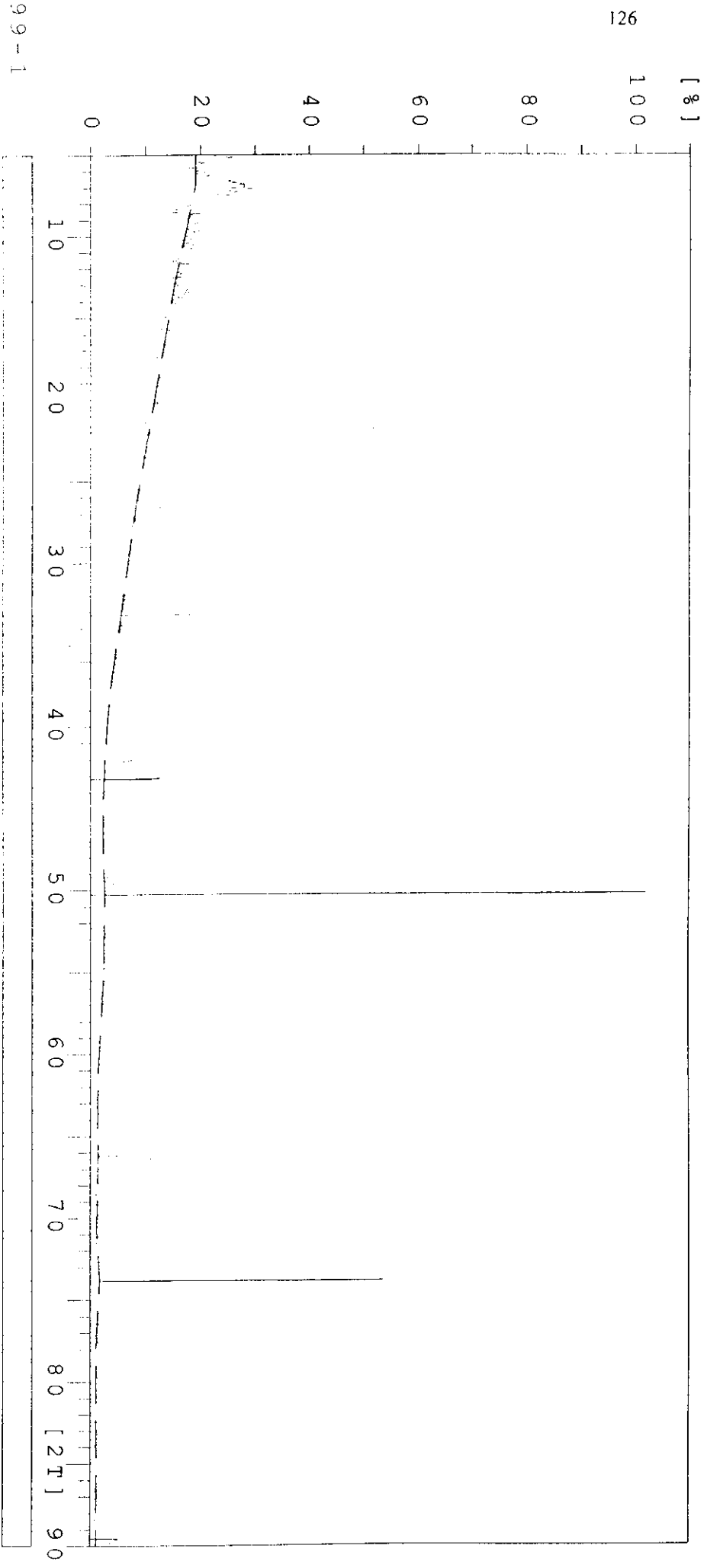
Code	Sample Name	JCPDF No.	Chemical Name	Chemical Formula
4199-1	The reaction products obtained from Magnesium reduction of rice husk white ash at 700 °C for 1 hr	26-1481	Silicon	Si
		04-0829	Periclase, syn	MgO
		44-1154	Aluminum Magnesium	Al <sub>0.58</sub> Mg <sub>0.42</sub>
		04-0768	Forsterite, syn	Mg <sub>2</sub> SiO <sub>4</sub>

  
 (Mr.Terdtoon Dumrongrittamatt)

Analyst

  
 (Mr.Terdtoon Dumrongrittamatt)

Inspector



4199-1

26-1481

04-0829

44-1154

PERICLASE

Periclase, syn

ALUMINUM MAGNESIUM

SI

MgO

Al<sub>0.58</sub>Mg<sub>0.42</sub>

14-jan-1999 11:19

D:\APDW\DATA\4199-1.DI

Physics Equipment Center

Prince of Songkla University

## D I F F R A C T I O N L I N E S :

Sample identification: 700C 1hr

DI file name: 4199-1.DI

Input file name: 700C1hr

Start angle [ $^{\circ}2\theta$ ]: 5.025End angle [ $^{\circ}2\theta$ ]: 89.975Start d-value [ $\text{\AA}$ ]: 20.40452End d-value [ $\text{\AA}$ ]: 1.26526

Maximum number of counts: 1037

Anode material: Co

a1 Wavelength [ $\text{\AA}$ ]: 1.78896a2 Wavelength [ $\text{\AA}$ ]: 1.79285

## Intensities for FIXED slit

Peak positions defined by: Minimum of 2nd derivative of peak

Minimum peak tip width: 0.00

Maximum peak tip width: 1.00

Maximum peak base width: 2.00

Minimum significance: 0.75

Number of peaks: 25

## D I F F R A C T I O N L I N E S :

Angle [ $2\theta$ ]	d-value a1 [ $\text{\AA}$ ]	d-value a2 [ $\text{\AA}$ ]	T.width [ $^{\circ}2\theta$ ]	Height [counts]	Backgr. [counts]	Rel.int. [%]	Signific
890	14.88558	14.91795	0.700	81	199	7.8	1.93
370	7.68383	7.70054	0.600	22	156	2.1	0.81
635	3.88319	3.89163	0.150	50	85	4.9	1.01
175	3.13326	3.14007	0.250	433	58	41.7	6.73
750	2.76497	2.77098	0.250	77	37	7.5	2.03
595	2.64095	2.64669	0.600	16	32	1.5	1.31
760	2.50968	2.51514	0.150	81	28	7.8	1.07
070	2.49202	2.49744	0.100	44	27	4.2	0.88
675	2.45830	2.46365	0.150	83	27	8.0	3.29
130	2.43358	2.43888	0.200	110	26	10.6	1.79
490	2.41440	2.41965	0.250	56	25	5.4	0.83
950	2.33985	2.34494	0.500	21	24	2.0	0.97



81

Wavelength= 1.54056 \*

$d$ Å	Int	h	k	l
3.1350	100	1	1	1
1.92020	55	2	2	0
1.63760	30	3	1	1
1.35760	6	4	0	0
1.24590	11	3	3	1
1.10870	12	4	2	2
1.04510	6	5	1	1
960100	3	4	4	0
918000	7	5	3	1
858700	8	6	2	0
828200	3	5	3	3

Cu  $\lambda$ : 1.5405 Filter: d-sp:  
 Int.: l/teor.: 4.70

Cubic S.G.: Fd3m (227)  
 309 b: c: A: C  
 $\beta$ :  $\gamma$ : Z: 8 mp:

bid.

2329 Dm: SS/FOM1 174(.0049, 13)

#: 7440-21-3. PSC: cF8. To replace 5-565. Deleted  
 7-1402. Mwt: 28.09. Volume[CD]: 160.18.

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829		Wavelength-- 1.5405 *			
		d Å	Int	h	k l
Cesium Oxide		2.43100	10	1	1 1
		2.1060	100	2	0 0
		1.48900	52	2	2 0
Phase, syn		1.27000	4	3	1 1
		1.21600	12	2	2 2
CuKαλ: 1.5405 Filter: Ni BetaM d-sp:		1.05330	5	4	0 0
θ: Int.: Diffract. I/cor.: 2.10		0.966500	2	3	3 1
Swanson, Tatge, Natl. Bur. Stand. (U.S.), Circ. 539, I, 37		0.941900	17	4	2 0
(3)		0.860000	15	4	2 2
		0.810900	3	5	1 1

Cubic S.G.: Fm3m (225)  
 213 b: c: A: C:  
 β: γ: Z: 4 mp

ibid.

3.580 Dm: 3.560 SS/FOM<sub>1</sub>  $\chi^2=56(0.180, 10)$

$\eta_{\omega\beta}$ : 1.732  $\epsilon_{\gamma}$ : Sign: 2V:

Dana's System of Mineralogy, 7th Ed., II, 499

Colorless

Sample taken at 26 C. High purity phosphor sample from  
 heated at 1800 C for 3 hours. Spectrographic  
 analysis (%): Ca and Si 0.01-1.00, Al, B, Cr, Fe, Ni  
 1-0.01. Pattern reviewed by Martin, K., McCarthy, G., North  
 Dakota State Univ., Fargo, ND, USA, ICDD Grant-in-Aid  
 0). Except for (220) reflections, there is good  
 agreement with experimental and calculated patterns.  
 Experimental pattern had I(220)=28; the calculated  
 is I(220)=49. Cl Na type. Halite group, periclase  
 group. Also called: magnesia.PSC: cF8. Deleted by  
 46; better unit cell; Weissmann 8/93. Mwt: 40.30.  
 Time[CD]: 74.78.

					Wavelength = 1.54056										
					d Å	Int	h	k	l	d Å	Int	h	k	l	
0768															
SiO <sub>2</sub>															
Magnesium Silicate					5.11000	26	0	2	0	1.53100	1	3	0	1	
					3.88000	69	0	2	1	1.51400	10	3	2	0	
					3.73000	25	1	0	1	1.49700	27	0	0	4	
sterite, syn					3.48700	21	1	2	0	1.47900	30	0	6	2	
					3.00000	17	0	0	2	1.43800	4	3	3	0	
d: Cu	λ: 1.5405	Filter:			d-sp:	2.76800	53	1	3	0	1.39600	12	2	3	3
off:	Int:			I/Cor:	2.51300	73	1	3	1	1.39400	9	1	7	0	
					2.45800	100	1	1	2	1.35100	17	3	2	2	
					2.34800	9	0	4	1	1.31600	9	1	3	4	
					2.31600	9	2	1	0	1.29500	2	0	6	3	
					2.26800	59	1	2	2	1.26600	1	2	0	4	
					2.25000	33	1	4	0	1.25600	1	2	6	2	
					2.16100	15	2	1	1	1.24600	2	1	4	4	
Orthorhombic	S.G.: Pbnm (62)				2.08400	5	1	3	2	1.24200	2	3	0	3	
a: 4.76	b: 10.20	c: 5.99	A: 0.4667	C: 0.5873	1.94500	4	0	4	2	1.22600	1	3	5	1	
	β:	γ:	Z: 4	mp:	1.87800	5	1	5	0	1.18900	1	4	0	0	
Ibid.					1.81100	2	1	1	3	1.16600	2	0	2	5	
					1.79200	3	1	5	1	1.15500	1	3	5	2	
					1.74800	60	2	2	2	1.14760	1	2	7	2	
3.213	Dm:	SS/FOM <sub>3</sub> (=12(.039, 65))			1.67000	13	2	4	1	1.13690	2	2	6	3	
					1.63600	12	0	6	1	1.12550	1	2	8	0	
					1.61800	15	1	3	3	1.09870	1	1	3	5	
					1.58900	2	1	5	2	1.03600	3	3	3	4	
					1.57200	10	0	4	3	1.02010	3	0	10	0	

D. Cell: a=5.990, b=10.200, c=4.760, a/b=0.5873,  
 =0.4667, S.G.=Pmnb(62). PSC: oP28. Deleted by 21-1260.  
 wt: 140.69. Volume[CD]: 290.83.

d Å	Int	h	k	l
.979700	1	0	2	6
.926600	1	4	6	2
.906100	1	2	2	6
.874800	1	4	4	4
.849500	1	3	10	1
.833100	7	4	2	5
.828100	9	3	8	4

1154		Wavelength= 1.7902			
0.58Mg0.42		d Å	Int	h	k l
Aluminum Magnesium		2.4900	81		
		2.4300	100		
		2.3380	10		
		2.2100	30		
		2.1490	13		
CoKa λ: 1.7902 Filter:		d-sp: Diffractometer	2.1160	6	
off: Int.: Diffract. I/cor.:			2.0310	4	
			1.9960	6	
Kobayashi, K., Awazu, T., Shingu, P., Trans. Jpn. Inst.			1.4890	7	
t., 28, 934 (1987)			1.4460	10	
			1.4280	13	
		S.G.:	1.4200	14	
b:	c:	A:	C:		
β:	γ:	Z:	mp:		
Dm:		SS/FOM I=<1( . )			

assigned because unindexed. Prepared by melting the elements in an alumina crucible under argon, then rapidly solidifying by chill casting and forming into a ribbon using the single roller method. Phase X. Metastable phase. Silicon used as an internal stand. Mwt: 86.



ศูนย์เครื่องมือวิทยาศาสตร์ มหาวิทยาลัยสงขลานครินทร์  
 ชั้น 1 อาคารบริหารวิชาการรวม มหาวิทยาลัยสงขลานครินทร์ วิทยาเขตหาดใหญ่ อำเภอหาดใหญ่ จังหวัดสงขลา 90110  
 Scientific Equipment Center, Prince of Songkla University  
 Central Academic Administrator Bld. Hat-Yai Campus, Songkhla 90110 Tel.0 7428 6904-7 Fax.0 7421 2813

F-RES-003/E Rev. 3 01/11/45

No. 2981/46 Page 1/1

## ANALYTICAL REPORT

Client Name and Address : Mr. Santi Rattanaviranon  
 Department of Physics, Faculty of Science, PSU.

Test Request Form No.: 3911/46

Test item(s) received date : September 24, 2003

Test performed date : September 25, 2003

Test Method used : Refer to WI-RES-LPSA-001

Analytical Instrument : Laser Particle Size Analyzer (COULTER LS230)

Analytical Technique: Laser Light Scatter Particle Size Distribution

Analytical Condition : Measures Size Distribution of Particles Suspended in Liquid (Water).  
 Run Speed 70 % Model Psl.rfd

Test item(s) description : 1. Rice husk ash was milled for 24 hrs.      **Quantity:** 1 sample

## Test Result :

1. Rice husk ash was milled for 24 hrs.	Sample Particle Size 0.545 to 30.07 $\mu\text{m}$		
	Volume (%)	Mean ( $\mu\text{m}$ )	S.D. ( $\mu\text{m}$ )
Analyze No1 Rice_11	100	4.510	3.374
Analyze No2 Rice_12	100	4.499	3.349
Analyze No3 Rice_13	100	4.475	3.279
Analyze No4 Rice_14	100	4.436	3.188
Analyze No5 Rice_15	100	4.415	3.142
Analyze No6 Rice_16	100	4.397	3.103
Analyze No7 Rice_17	100	4.377	3.059

\* As show as the detail documents of sample.

( Mr. Sutee Padungkul )

Analyst

( Mr. Terdtoon Dumrongritatt )

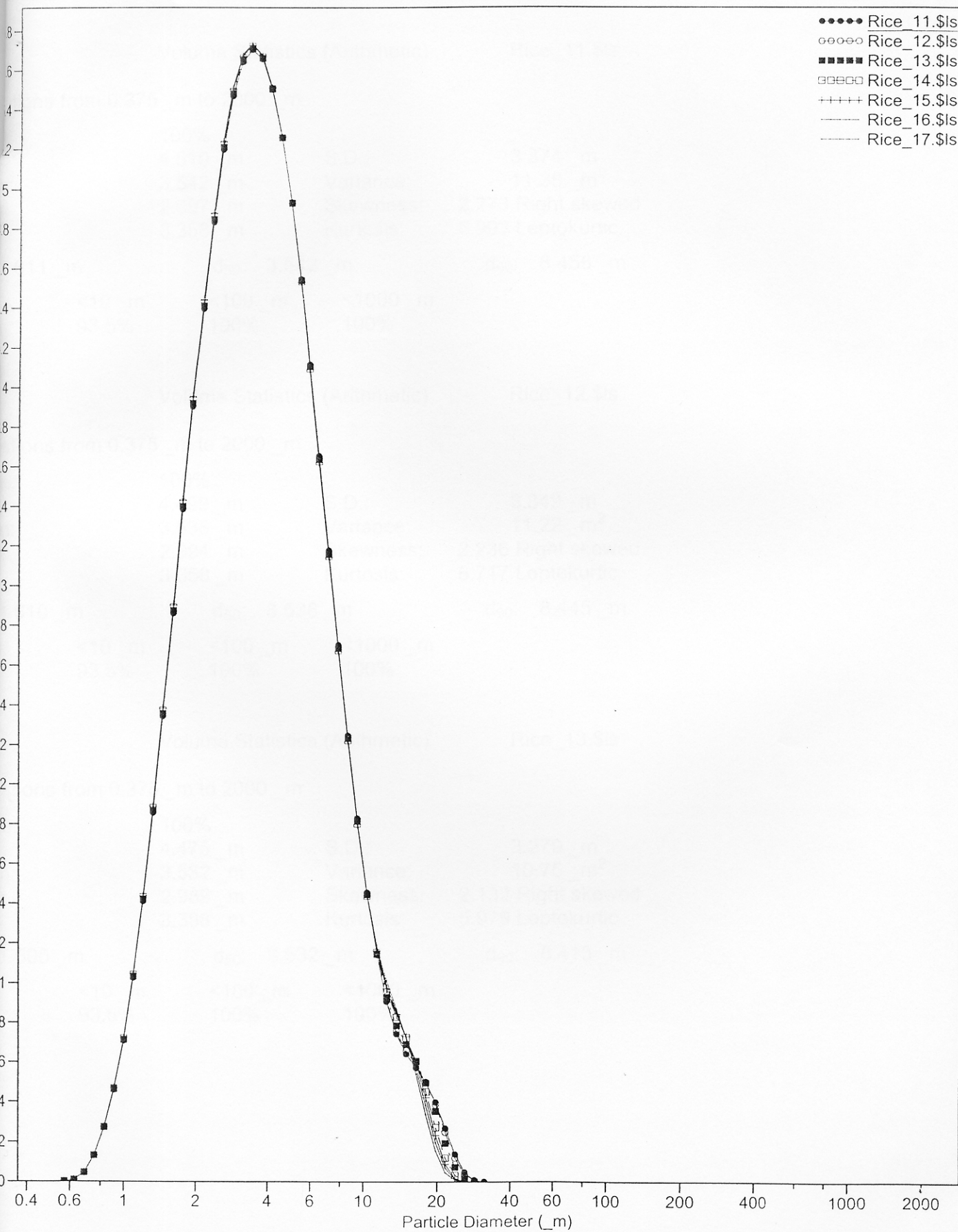
Inspector

## LS Particle Size Analyzer

25 Sep 2003 16:17

BECKMAN  
CULTER™

Differential Volume



## LS Particle Size Analyzer

BECKMAN  
MULTER

25 Sep 2003 16:1

## Volume Statistics (Arithmetic)

Rice\_11.\$Is

ations from 0.375 \_m to 2000 \_m

me:	100%		
	4.510 _m	S.D.:	3.374 _m
n:	3.542 _m	Variance:	11.38 _m <sup>2</sup>
	2.997 _m	Skewness:	2.273 Right skewed
	3.358 _m	Kurtosis:	6.993 Leptokurtic
1.611 _m	d <sub>50</sub> :	3.542 _m	d <sub>90</sub> : 8.456 _m
<10 _m	<100 _m	<1000 _m	
93.5%	100%	100%	

## Volume Statistics (Arithmetic)

Rice\_12.\$Is

ations from 0.375 \_m to 2000 \_m

me:	100%		
	4.499 _m	S.D.:	3.349 _m
n:	3.538 _m	Variance:	11.22 _m <sup>2</sup>
	2.994 _m	Skewness:	2.236 Right skewed
	3.358 _m	Kurtosis:	6.717 Leptokurtic
1.610 _m	d <sub>50</sub> :	3.538 _m	d <sub>90</sub> : 8.445 _m
<10 _m	<100 _m	<1000 _m	
93.5%	100%	100%	

## Volume Statistics (Arithmetic)

Rice\_13.\$Is

ations from 0.375 \_m to 2000 \_m

me:	100%		
	4.475 _m	S.D.:	3.279 _m
n:	3.532 _m	Variance:	10.75 _m <sup>2</sup>
	2.989 _m	Skewness:	2.132 Right skewed
	3.358 _m	Kurtosis:	5.979 Leptokurtic
1.608 _m	d <sub>50</sub> :	3.532 _m	d <sub>90</sub> : 8.415 _m
<10 _m	<100 _m	<1000 _m	
93.6%	100%	100%	

## LS Particle Size Analyzer

ECKMAN  
ULTER..

25 Sep 2003 16:17

## Volume Statistics (Arithmetic)

Rice\_14.\$ls

ations from 0.375 \_m to 2000 \_m

100%	S.D.:	3.188 _m
4.436 _m	Variance:	10.17 _m <sup>2</sup>
3.519 _m	Skewness:	2.019 Right skewed
2.980 _m	Kurtosis:	5.248 Leptokurtic
3.358 _m		

1.604 _m	d <sub>50</sub> :	3.519 _m	d <sub>90</sub> :	8.358 _m
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<10 _m	<100 _m	<1000 _m
93.7%	100%	100%

## Volume Statistics (Arithmetic)

Rice\_15.\$ls

ations from 0.375 \_m to 2000 \_m

100%	S.D.:	3.142 _m
4.415 _m	Variance:	9.869 _m <sup>2</sup>
3.512 _m	Skewness:	1.964 Right skewed
2.975 _m	Kurtosis:	4.904 Leptokurtic
3.358 _m		

1.602 _m	d <sub>50</sub> :	3.512 _m	d <sub>90</sub> :	8.323 _m
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<10 _m	<100 _m	<1000 _m
93.8%	100%	100%

## Volume Statistics (Arithmetic)

Rice\_16.\$ls

ations from 0.375 \_m to 2000 \_m

100%	S.D.:	3.103 _m
4.397 _m	Variance:	9.631 _m <sup>2</sup>
3.507 _m	Skewness:	1.925 Right skewed
2.970 _m	Kurtosis:	4.690 Leptokurtic
3.358 _m		

1.601 _m	d <sub>50</sub> :	3.507 _m	d <sub>90</sub> :	8.293 _m
----------	-------------------	----------	-------------------	----------

<10 _m	<100 _m	<1000 _m
93.9%	100%	100%



# LS Particle Size Analyzer

BECKMAN  
FILTER

25 Sep 2003 16:17

## Volume Statistics (Arithmetic)

Rice\_17.\$ls

ions from 0.375 \_m to 2000 \_m

100%  
 4.377 \_m      S.D.:            3.059 \_m  
 3.501 \_m      Variance:        9.355 \_m<sup>2</sup>  
 2.965 \_m      Skewness:       1.871 Right skewed  
 3.358 \_m      Kurtosis:        4.371 Leptokurtic

599 \_m            d<sub>50</sub>: 3.501 \_m            d<sub>90</sub>: 8.262 \_m

<10 \_m            <100 \_m            <1000 \_m  
 94.0%            100%            100%

	Rice_11.\$ls	Rice_12.\$ls	Rice_13.\$ls	Rice_14.\$ls	Rice_15.\$ls	Rice_16.\$ls	Rice_17.\$ls
ter	Volume	Volume	Volume	Volume	Volume	Volume	Volume
	% <	% <	% <	% <	% <	% <	% <
2	0.17	0.17	0.17	0.17	0.17	0.17	0.17
1	1.27	1.27	1.28	1.28	1.29	1.29	1.30
2	18.2	18.2	18.3	18.4	18.4	18.5	18.6
3	39.9	39.9	40.0	40.2	40.3	40.4	40.5
4	57.3	57.3	57.4	57.7	57.8	57.9	58.0
5	69.8	69.8	69.9	70.2	70.3	70.4	70.5
7	84.4	84.5	84.5	84.7	84.8	84.9	85.0
8	93.5	93.5	93.6	93.7	93.8	93.9	94.0
9	99.4	99.4	99.6	99.7	99.8	99.8	99.9
0	100	100	100	100	100	100	100
0	100	100	100	100	100	100	100
2	100	100	100	100	100	100	100

nel	Rice_11.\$ls	Rice_12.\$ls	Rice_13.\$ls	Rice_14.\$ls	Rice_15.\$ls	Rice_16.\$ls
ter	Diff.	Diff.	Diff.	Diff.	Diff.	Diff.
	Volume	Volume	Volume	Volume	Volume	Volume
	%	%	%	%	%	%
	_m					
1	0.375	0	0	0	0	0
2	0.412	0	0	0	0	0
3	0.452	0	0	0	0	0
4	0.496	0	0	0	0	0
5	0.545	0.00060	0.00060	0.00060	0.00058	0.00057
6	0.598	0.0081	0.0081	0.0081	0.0080	0.0079
7	0.656	0.045	0.045	0.045	0.045	0.045
8	0.721	0.13	0.13	0.13	0.13	0.13
9	0.791	0.27	0.27	0.27	0.27	0.28
0	0.868	0.46	0.46	0.46	0.47	0.47
1	0.953	0.71	0.71	0.71	0.72	0.72
2	1.047	1.02	1.03	1.03	1.04	1.05
3	1.149	1.41	1.41	1.42	1.43	1.44
4	1.261	1.85	1.86	1.87	1.88	1.89
5	1.384	2.34	2.35	2.36	2.37	2.38
6	1.520	2.86	2.86	2.87	2.89	2.91
7	1.668	3.38	3.39	3.40	3.42	3.44
8	1.832	3.90	3.91	3.92	3.94	3.96
9	2.011	4.39	4.40	4.41	4.43	4.45
0	2.207	4.83	4.84	4.85	4.86	4.88

## LS Particle Size Analyzer

BECKMAN  
LTER..

25 Sep 2003 16:17

Channel Diameter (Lower) _m	Rice_11.\$Is Diff. Volume %	Rice_12.\$Is Diff. Volume %	Rice_13.\$Is Diff. Volume %	Rice_14.\$Is Diff. Volume %	Rice_15.\$Is Diff. Volume %	Rice_16.\$ Diff. Volume %
2.423	5.19	5.20	5.21	5.22	5.23	5.24
2.660	5.47	5.47	5.48	5.49	5.50	5.51
2.920	5.64	5.64	5.65	5.66	5.67	5.68
3.205	5.70	5.70	5.71	5.72	5.73	5.73
3.519	5.65	5.65	5.66	5.67	5.67	5.67
3.863	5.50	5.50	5.50	5.51	5.51	5.51
4.240	5.25	5.25	5.25	5.25	5.26	5.26
4.655	4.93	4.92	4.93	4.92	4.92	4.92
5.110	4.54	4.54	4.54	4.53	4.53	4.53
5.610	4.11	4.11	4.10	4.09	4.09	4.08
6.158	3.65	3.64	3.64	3.62	3.62	3.61
6.760	3.17	3.17	3.16	3.14	3.14	3.13
7.421	2.70	2.69	2.68	2.67	2.67	2.66
8.147	2.24	2.24	2.23	2.22	2.21	2.21
8.943	1.83	1.82	1.81	1.80	1.79	1.79
9.818	1.45	1.45	1.44	1.44	1.44	1.44
10.78	1.14	1.14	1.14	1.15	1.16	1.17
11.83	0.90	0.91	0.92	0.95	0.97	0.99
12.99	0.74	0.75	0.78	0.83	0.84	0.85
14.26	0.64	0.66	0.69	0.72	0.73	0.72
15.65	0.57	0.58	0.60	0.61	0.59	0.58
17.18	0.50	0.50	0.49	0.45	0.42	0.38
18.86	0.39	0.38	0.35	0.27	0.23	0.20
20.71	0.27	0.25	0.19	0.12	0.087	0.069
22.73	0.14	0.12	0.072	0.031	0.017	0.012
24.95	0.048	0.037	0.014	0.0041	0.0013	0.00085
27.39	0.0084	0.0059	0.0011	0.00012	0	0
30.07	0.00057	0.00032	0	0	0	0
33.01	0	0	0	0	0	0
36.24	0	0	0	0	0	0
39.78	0	0	0	0	0	0
43.67	0	0	0	0	0	0
47.94	0	0	0	0	0	0
52.62	0	0	0	0	0	0
57.77	0	0	0	0	0	0
63.41	0	0	0	0	0	0
69.61	0	0	0	0	0	0
76.42	0	0	0	0	0	0
83.89	0	0	0	0	0	0
92.09	0	0	0	0	0	0
101.1	0	0	0	0	0	0
111.0	0	0	0	0	0	0
121.8	0	0	0	0	0	0
133.7	0	0	0	0	0	0
146.8	0	0	0	0	0	0
161.2	0	0	0	0	0	0
176.9	0	0	0	0	0	0
194.2	0	0	0	0	0	0
213.2	0	0	0	0	0	0
234.0	0	0	0	0	0	0
256.9	0	0	0	0	0	0
282.1	0	0	0	0	0	0
309.6	0	0	0	0	0	0
339.9	0	0	0	0	0	0

## LS Particle Size Analyzer

BECKMAN  
MULTER

25 Sep 2003 16:1

Channel Diameter (Lower) _m	Rice_11.\$Is Diff. Volume %	Rice_12.\$Is Diff. Volume %	Rice_13.\$Is Diff. Volume %	Rice_14.\$Is Diff. Volume %	Rice_15.\$Is Diff. Volume %	Rice_16. Diff. Volume %
373.1	0	0	0	0	0	0
409.6	0	0	0	0	0	0
449.7	0	0	0	0	0	0
493.6	0	0	0	0	0	0
541.9	0	0	0	0	0	0
594.8	0	0	0	0	0	0
653.0	0	0	0	0	0	0
716.8	0	0	0	0	0	0
786.9	0	0	0	0	0	0
863.9	0	0	0	0	0	0
948.3	0	0	0	0	0	0
1041	0	0	0	0	0	0
1143	0	0	0	0	0	0
1255	0	0	0	0	0	0
1377	0	0	0	0	0	0
1512	0	0	0	0	0	0
1660	0	0	0	0	0	0
1822	0	0	0	0	0	0
2000						



**ANALYTICAL REPORT**

**Client Name and Address :** Mr.Santi Rattanaviranon  
 Department of Physics, Faculty of Science, PSU.

**Test Request Form No.:** 4023/46

**Test item(s) received date :** November 7, 2003

**Test performed date :** November 10, 2003

**Test Method used :** Refer to F-RES-TGA-001

**Analytical Instrument :** Thermogravimetry Analyzer (PerkinElmer, TGA7)

**Analytical Technique:** Thermogravimetry Analysis

**Analytical Condition :** Scanning range : 100 °C – 1,200 °C      Purge gas : O<sub>2</sub>  
 Scanning rate : 10 °C/min.

**Test item(s) description :** Husk      **Quantity :** 1 sample

**Test Result:**

No.	Sample	File
1	3 N HCl acid – treated	4023_1

\* See details in the attached thermogram graph 1 page.

*Patchara Sukonrat*

( Miss.Patchara Sukonrat )

Analyst

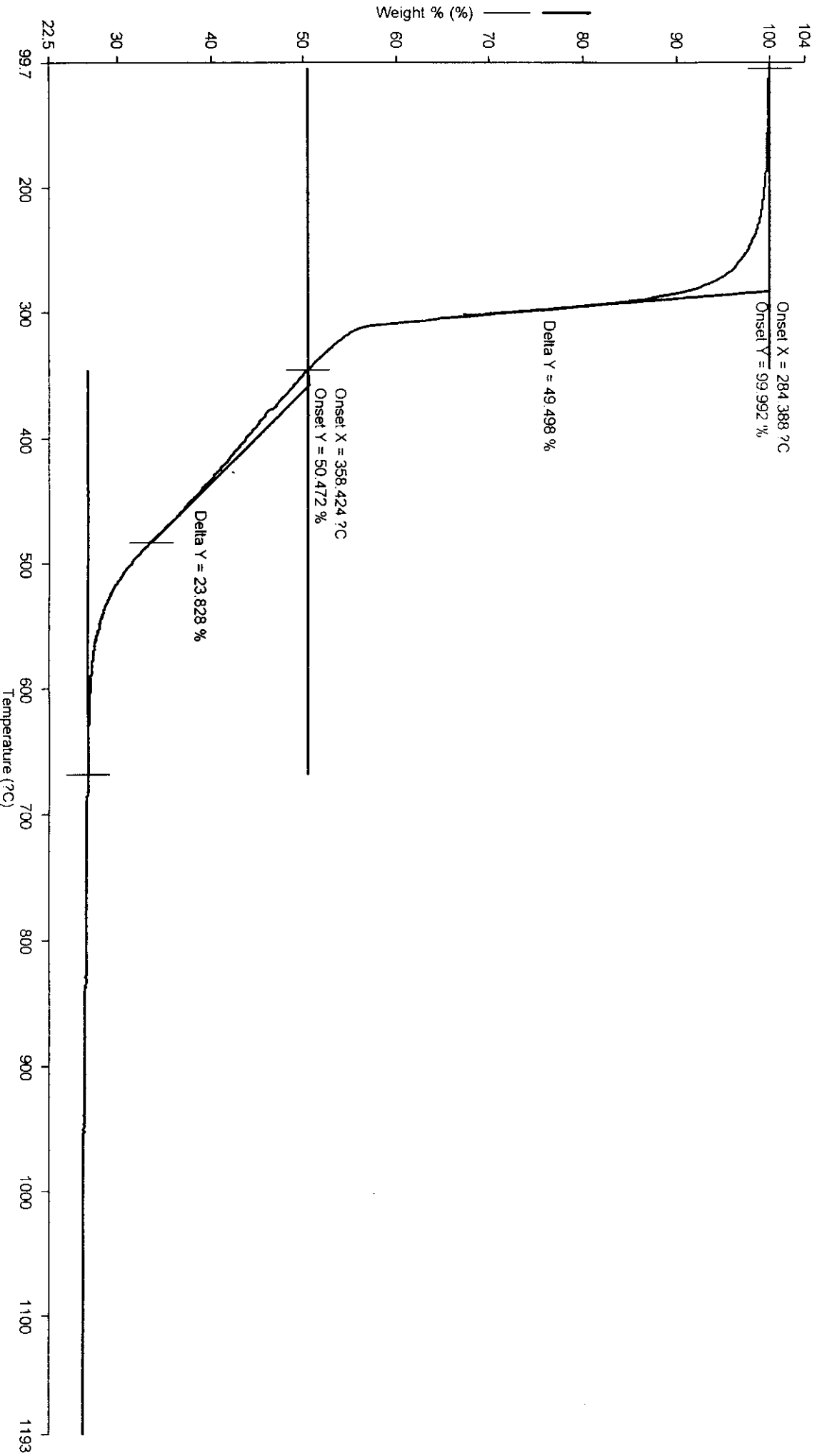
*Terdtoon Dumrongritamatt*

( Mr.Terdtoon Dumrongritamatt )

Inspector

Filename: c:\pelan\4023\4023\_1.thd - 9/6/96 6:22:23 AM  
Operator ID: patchara  
Sample ID: 3N HCl acid-treated  
Sample Weight: 5.971 mg  
Comment: 4023/46\_1/1\_Nov10\_2003

3N HCl acid-treated: 4023\_1.thd  
Weight % (%) Temperature Scan: Step: 1



1) Heat from 100.00°C to 1200.00°C at 10.00°C/min



F-RES-0031/E Rev. 3 01/11/45

No 3200/46 Page 1 / 1

### ANALYTICAL REPORT

**Client Name and Address :** Mr. Santi Rattanaviranon  
 Department of Physics, Faculty of Science , Prince of Songkla University

**Test Request Form No.:** 4115/46

**Test item(s) received date :** December 8, 2003

**Test performed date :** December 18 - 19, 2003

**Test Method used :** Refer to REF-RES-ICP/Si - 006 Rev.0

**Analytical Instrument :** Optical Emission Spectrometer ( Optima 4300 DV) Perkin Elmer Instruments

**Analytical Technique:** Inductively Coupled Plasma Optical Emission Spectrometry

**Analytical Condition :** Wavelength Mg = 285.213 nm, Al = 396.153 nm, Ca = 393.366 nm  
 Fe = 238.204 nm, Mn = 260.568 nm, P = 213.617 nm  
 K = 766.490 nm

**Test item(s) description :** Rice husk **Quantity :** 1 sample

**Test Result :**

No	Elements	3N HCl (pretreated) + Conc. HNO <sub>3</sub> (posttreated) 700°C for 3 hr in O <sub>2</sub> atmosphere 1 L/min, 15 °C/min	
		Concentration (mg/kg)	%RSD
1	Mg	34.75	0.18
2	Al	324.0	1.26
3	Ca	49.88	1.00
4	Fe	83.12	0.62
5	Mn	11.00	2.51
6	P	< LOQ	-
7	K	20.25	0.75

- Limit of quantitation; Mg=1µg/L, Al=17µg/L, Ca=2µg/L, Fe=2µg/L, Mn=1µg/L, P=66µg/L, K=21µg/L
- Refer raw data at 4115-46, 4115-46(1), 4115-46(K Si), 4115-46(K Si)2

(Mr. Wiangchai Chongsrirattanakun)

Analyst

(Mr. Terdtoon Dumrongrittamatt)

Inspector

**Remark** This analytical report is valid only for the tested sample and raw data of result(s) will be saved at least a month.

This test report shall not be reproduced except in full, without written approval of the laboratory.



**ANALYTICAL REPORT**

**Client Name and Address :** Mr.Santi Rattanaviranon  
 Department of Physic , Faculty of Science , PSU.

**Test Request Form No.:** 4123/46

**Test item(s) received date :** December 11, 2003

**Test performed date :** December 12, 2003

**Test Method used :** In house method refer to WI-RES-CHNS-O-001

**Analytical Instrument :** CE Instruments Flash 1112 Series EA CHNS-O Analyser

**Analytical Technique:** Dynamic Flash Combustion

**Analytical Condition :** Furnace temperature : 900 °C oven temperature : 65 °C  
 Carrier flow : 130 mL/min oxygen flow : 250 mL/min  
 reference flow : 100 mL/min

**Test item(s) description :** Unknown sample **Quantity :** 1 sample

**Test Result :**

Sample	% Carbon ( with % RSD )
3 N of HCl , fired at 700°C for 3 hrs , in O <sub>2</sub> atmosphere 1 L/min , 15 °C/min	Less than 0.01

The results are refer to folder 4123

Songsuda.  
 (Songsuda Promthong)

**Analyst**

Terdtoon Dumrongrittamatt  
 (Terdtoon Dumrongrittamatt)

**Inspector**

Eager 300 Summarize Results

Date : 12/12/03 at 18:59:41. 143

Method Name : Nitrogen/Carbon/Hydrogen/Sulphur  
 Method Filename : 4123n1.mth

Group No : 1	Element %			
Sample Name	Nitrogen%	Carbon%	Hydrogen%	Sulphur%
Sample	0	0	0.1422698349	0
Sample	0	0	0.157178849	0
Sample	0	0	0.1573538631	0

3 Sample(s) in Group No : 1

Component Name	Average	Std. Dev.	% Rel. S. D.	Variance
Hydrogen%	0	0	0.0000	0.0000
Carbon%	0	0	0.0000	0.0000
Nitrogen%	0.1522675157	8.658688E-03	5.6865	0.0001
Sulphur%	0	0	0.0000	0.0000





### ANALYTICAL REPORT

**Client Name and Address :** Mr.Santi Rattanaviranon  
 Department of Physics, Faculty of Science, Prince of Songkla University.

**Test Request Form No.:** 4329/47

**Test item(s) received date :** February 4, 2004

**Test performed date :** February 6, 2004

**Test Method used :** In house method refer to WI-RES-SEM5800-001 and WI-RES-SEM-002

**Analytical Instrument :** Scanning Electron Microscope (JSM-5800LV,JEOL)  
 Attached with Energy Dispersive X-ray Spectrometer(EDS: Oxford ISIS 300)

**Analytical Technique:** Electron Microanalysis

**Analytical Condition :** High Vacuum Mode, Brass Stub without Coating

**Test item(s) description :** Silicon **Quantity :** 1 sample.

**Test Result :**

Sample No.	Sample name	%Element(SD)	
		Mg	Si
1	The purified silicon from rice husk ash.	0.39(0.04)	99.61(0.04)

The spectrum and data are shown in the attachment 3 pages. (Refer to C:\isis\ac1)

Remark : Analysed all elements normalised.

*Pornpot Nuthong*

(Mr. Pornpot Nuthong)

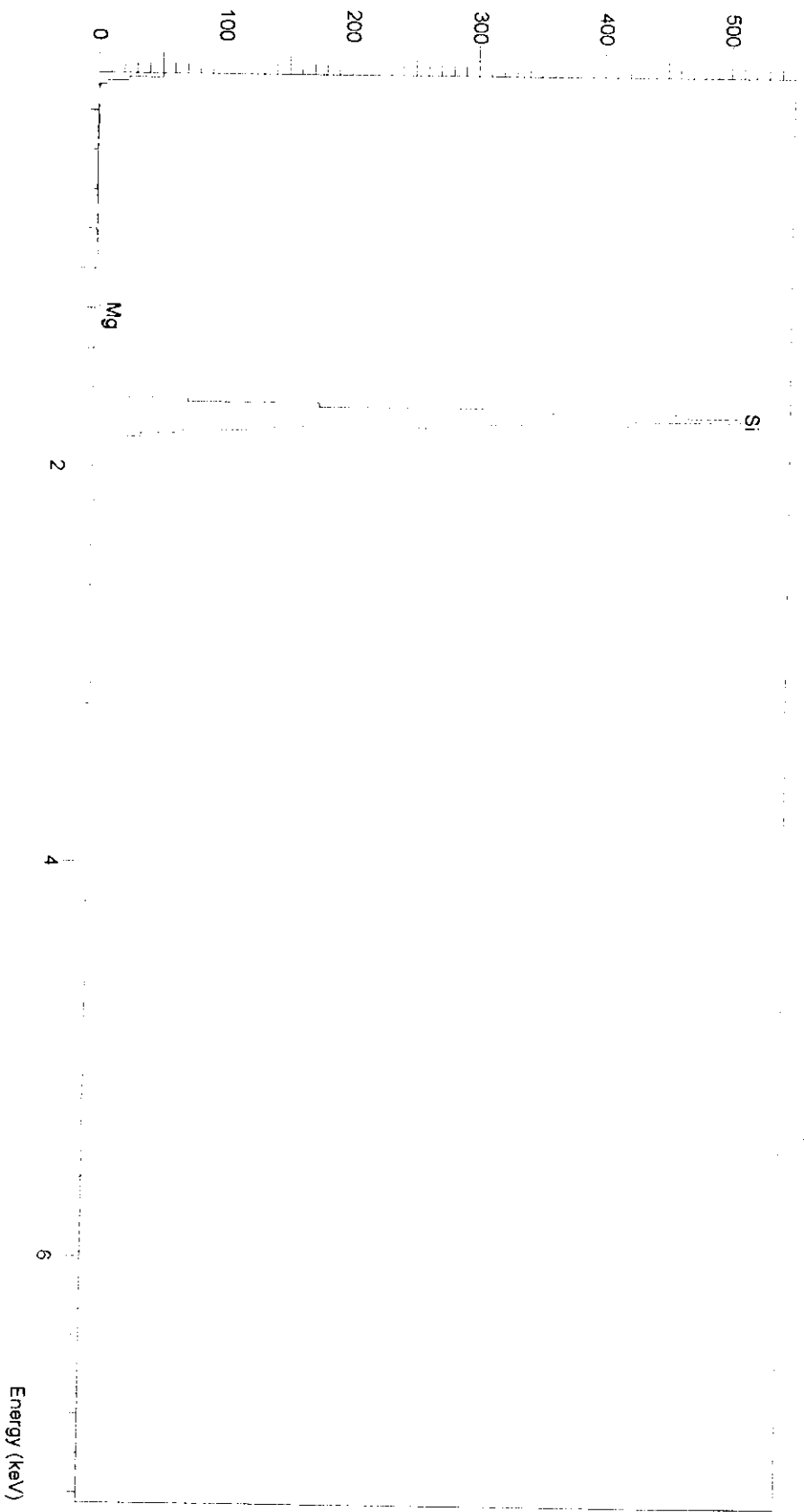
Analyst

*Patchara Sukonrat*

(Ms. Patchara Sukonrat)

Inspector

Operator : pornpot  
Client : Department of Physics, Faculty of Science, PSU  
Job : 4329 Santi  
4329-1 (06/02/04 10:03)



SEMQuant results. Listed at 11:05:32 on 09/02/04

Operator: pompot

Client: Department of Physics, Faculty of Science, PSU

Job: 4329 Santi

Spectrum label: 4329-1				Spectrum label: 4329-6			
Element	Type	Spect. Element(%)	Atomic (%)	Element	Type	Spect. Element(%)	Atomic (%)
Mg K	ED	0.42	0.49	Mg K	ED	0.43	0.49
Si K	ED	99.58	99.51	Si K	ED	99.57	99.51
Total		100.00	100.00	Total		100.00	100.00
Spectrum label: 4329-2				Spectrum label: 4329-7			
Element	Type	Spect. Element(%)	Atomic (%)	Element	Type	Spect. Element(%)	Atomic (%)
Mg K	ED	0.34	0.40	Mg K	ED	0.43	0.50
Si K	ED	99.66	99.60	Si K	ED	99.57	99.50
Total		100.00	100.00	Total		100.00	100.00
Spectrum label: 4329-3				Spectrum label: 4329-8			
Element	Type	Spect. Element(%)	Atomic (%)	Element	Type	Spect. Element(%)	Atomic (%)
Mg K	ED	0.37	0.42	Mg K	ED	0.36	0.42
Si K	ED	99.63	99.58	Si K	ED	99.64	99.58
Total		100.00	100.00	Total		100.00	100.00
Spectrum label: 4329-4				Spectrum label: 4329-9			
Element	Type	Spect. Element(%)	Atomic (%)	Element	Type	Spect. Element(%)	Atomic (%)
Mg K	ED	0.38	0.43	Mg K	ED	0.36	0.42
Si K	ED	99.62	99.57	Si K	ED	99.64	99.58
Total		100.00	100.00	Total		100.00	100.00
Spectrum label: 4329-5				Spectrum label: 4329-10			
Element	Type	Spect. Element(%)	Atomic (%)	Element	Type	Spect. Element(%)	Atomic (%)
Mg K	ED	0.44	0.51	Mg K	ED	0.36	0.42
Si K	ED	99.56	99.49	Si K	ED	99.64	99.58
Total		100.00	100.00	Total		100.00	100.00

\* = &lt;2 Sigma