LAMPIRAN

Tabel A.1. Hasil Pengamatan Pada Proses Pembuatan *Nata de Coco*

BENTUK SAMPEL	KODE SAMPEL	VARIASI (%)			TEBAL Rata-rata (mm)	MASSA (gram)		PERSENTASE SERAT	*MOISTURE CONTENT* (%)	KETERANGAN
		ASETAT	GULA	UREA		BASAH	KERING			
 	$Aa_1\alpha$	0,25%	1,50%	0,40%	10,32	463	4,75	1,026	8,75	(pH : 4,0) Putih Bening
	$Aa_1\beta$	0,25%	1,50%	0,50%	13,65	532	5,27	0,991	8,52	(pH : 4,1) Putih Bening
	$Aa_1\gamma$	0,25%	1,50%	0,60%	11,09	482	4,98	1,033	9,44	(pH : 4,2) Putih Bening
	$Aa_2\alpha$	0,25%	2,00%	0,40%	10,63	479	4,86	1,015	8,00	(pH : 4,1) Putih Bening
	$Aa_2\beta$	0,25%	2,00%	0,50%	13,02	516	5,11	0,990	10,49	(pH : 4,1) Putih Bening
	$Aa_2\gamma$	0,25%	2,00%	0,60%	9,80	445	4,55	1,022	10,24	(pH : 4,0) Putih Bening
	$Aa_3\alpha$	0,25%	2,50%	0,40%	9,13	439	4,41	1,005	8,77	(pH : 4,0) Putih Bening
	$Aa_3\beta$	0,25%	2,50%	0,50%	13,68	538	5,28	0,981	8,80	(pH : 4,1) Putih Bening
	$Aa_3\gamma$	0,25%	2,50%	0,60%	10,21	450	4,76	1,058	9,83	(pH : 4,1) Putih Bening

BENTUK SAMPEL	KODE SAMPEL	VARIASI (%)			TEBAL Rata-rata (mm)	MASSA (gram)		PERSENTASE SERAT	MOISTURE CONTENT (%)	KETERANGAN
		ASETAT	GULA	UREA		BASAH	KERING			
 Serat Basah  Serat Kering	$Ba_1\alpha$	0,30%	1,50%	0,40%	10,35	456	4,77	1,046	8,92	(pH : 3,7) Putih Bening
	$Ba_1\beta$	0,30%	1,50%	0,50%	14,07	560	5,51	0,984	8,57	(pH : 3,8) Putih Bening
	$Ba_1\gamma$	0,30%	1,50%	0,60%	10,42	466	4,67	1,002	10,31	(pH : 3,9) Putih Bening
	$Ba_2\alpha$	0,30%	2,00%	0,40%	10,43	467	4,66	0,998	9,25	(pH : 3,7) Putih Bening
	$Ba_2\beta$	0,30%	2,00%	0,50%	14,57	595	5,77	0,970	9,78	(pH : 3,8) Putih Bening
	$Ba_2\gamma$	0,30%	2,00%	0,60%	13,69	534	5,43	1,017	8,29	(pH : 3,9) Putih Bening
	$Ba_3\alpha$	0,30%	2,50%	0,40%	13,28	544	5,47	1,006	10,35	(pH : 3,6) Putih Bening
	$Ba_3\beta$	0,30%	2,50%	0,60%	14,18	566	5,55	0,981	9,48	(pH : 3,7) Putih Bening
	$Ba_3\gamma$	0,30%	2,50%	0,50%	13,03	531	5,38	1,013	8,97	(pH :3,7) Putih Bening

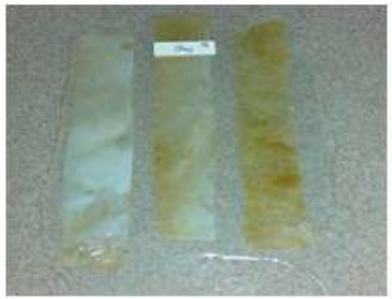
BENTUK SAMPEL	KODE SAMPEL	VARIASI (%)			TEBAL Rata-rata (mm)	MASSA (gram)		PERSENTASE SERAT	MOISTURE CONTENT (%)	KETERANGAN
		ASETAT	GULA	UREA		BASAH	KERING			
 Serat Basah	$Ca_1\alpha$	0,35%	1,50%	0,40%	12,43	499	5,23	1,048	8,76	(pH : 3,5) Putih Bening
	$Ca_1\beta$	0,35%	1,50%	0,50%	13,60	538	5,30	0,985	10,12	(pH : 3,5) Putih Bening
	$Ca_1\gamma$	0,35%	1,50%	0,60%	11,41	477	4,80	1,006	8,91	(pH : 3,5) Putih Bening
	$Ca_2\alpha$	0,35%	2,00%	0,40%	12,54	498	5,03	1,010	9,32	(pH : 3,5) Putih Bening
	$Ca_2\beta$	0,35%	2,00%	0,50%	13,87	545	5,39	0,989	9,67	(pH : 3,5) Putih Bening
 Serat Kering	$Ca_2\gamma$	0,35%	2,00%	0,60%	11,65	476	4,79	1,006	10,01	(pH : 3,6) Putih Bening
	$Ca_3\alpha$	0,35%	2,50%	0,40%	10,84	469	4,89	1,043	8,95	(pH : 3,5) Putih Bening
	$Ca_3\beta$	0,35%	2,50%	0,50%	10,51	473	4,81	1,017	8,52	(pH : 3,5) Putih Bening
	$Ca_3\gamma$	0,35%	2,50%	0,60%	13,25	501	5,31	1,060	9,67	(pH : 3,6) Putih Bening

Tabel A.2. Hasil Uji Kuat Tarik (*Tensile Strength*)

BENTUK SAMPEL	KODE SAMPEL	MAX FORCE (N)	MAX STRAIN (%)	TENSILE (MPa)		% Elongation at Break	Hasil Uji Tarik Komposit
				STRENGTH	MODULUS		
	SiO_2-EP-1	28,797	2,620	4,21	914,89	5,190	
	SiO_2-EP-2	19,062	1,104	2,81	355,72	7,826	
	Al_2O_3-EP-1	93,016	5,758	12,98	1.456,85	6,082	
	Al_2O_3-EP-2	67,922	1,810	11,79	2.171,07	1,904	

BENTUK SAMPEL	KODE SAMPEL	MAX FORCE (N)	MAX STRAIN (%)	TENSILE (MPa)		% Elongation at Break	Hasil Uji Tarik Komposit
				STRENGTH	MODULUS		
	Clay-EP-1	49,906	2,134	8,36	620,95	3,294	
	Clay-EP-2	69,172	3,000	10,97	771,23	4,790	
	SiO_2-VE-1	219,938	5,864	19,81	1.301,92	5,924	
	SiO_2-VE-2	157,625	4,698	15,02	954,85	4,730	

BENTUK SAMPEL	KODE SAMPEL	MAX FORCE (N)	MAX STRAIN (%)	TENSILE (MPa)		% Elongation at Break	Hasil Uji Tarik Komposit
				STRENGTH	MODULUS		
	SiO_2-PE-1	179,609	10,558	16,27	619,83	10,568	
	SiO_2-PE-2	81,094	2,054	7,00	690,96	2,918	
	Al_2O_3-PE-1	125,438	7,144	10,07	375,65	7,182	
	Al_2O_3-PE-2	106,813	7,754	8,84	245,22	11,888	

BENTUK SAMPEL	KODE SAMPEL	MAX FORCE (N)	MAX STRAIN (%)	TENSILE (MPa)		% Elongation at Break	Hasil Uji Tarik Komposit
				STRENGTH	MODULUS		
	Clay-PE-1	193,641	8,972	15,59	590,95	8,976	
	Clay-PE-2	84,094	2,666	7,76	562,89	2,792	

Keterangan :

EP – 1 : Epoksi untuk sampel ke-1

EP – 2 : Epoksi untuk sampel ke-2

VE – 1 : Vinil Ester untuk sampel ke-1

VE – 2 : Vinil Ester untuk sampel ke-2

PE – 1 : Poliester untuk sample ke-1

PE – 2 : Poliester untuk sample ke-2

Tabel A.3. Perbandingan Kuat Tarik dari Beberapa Material Logam [47]

Tipe Material	Spesifikasi	Komposisi	*Tensile Strength* (MPa)
Carbon Steel	A 131 Grade B	C 0,29; Mn 0,8; Si 0,4	400 – 500
Aluminium Alloy		Al-Cu-Mg	170 – 310
Aluminium Alloy		Al-Cu-Mg-Si	380 – 520
Aluminium Alloy		Al-Zn-Mg-Cu	520 – 620
Magnesium Alloy	AM100 A-T61	Al 10; Mn 0,1	275

Tabel A.4. Hasil Pengamatan Pertumbuhan Serat *Nata de Coco* dengan Penambahan Nanofiller

Tanggal	Hari Ke-	Media				Keterangan
		Tanpa Nanofiller	SiO2	Al_2O_3	Clay	
		pH (3,8)	pH (5,2)	pH (5,5)	pH (5,0)	
		Tebal (mm)	Tebal (mm)	Tebal (mm)	Tebal (mm)	
01 April 2010	0	0,00	0,00	0,00	0,00	Belum terbentuk serat pada media air kelapa dengan penambahan nanofiller
02 April 2010	1	2,55	0,00	0,00	0,00	
03 April 2010	2	8,11	0,00	0,00	0,00	
04 April 2010	3	12,43	0,00	0,00	0,00	
05 April 2010	4	15,15	0,00	0,00	1,00	
06 April 2010	5	18,10	1,25	0,00	1,52	Pada media dengan penambahan nanofiller Al_2O_3 tetap tidak terbentuk serat dan media menjadi berbusa dan busuk
07 April 2010	6	19,23	2,00	0,00	2,76	
08 April 2010	7	19,87	3,50	0,00	4,90	
09 April 2010	8	19,95	5,45	0,00	7,14	
10 April 2010	9	20,00	7,42	0,00	9,71	
11 April 2010	10	20,00	8,55	0,00	12,51	
12 April 2010	11	20,00	10,23	0,00	14,11	
13 April 2010	12	20,00	11,75	0,00	15,55	
14 April 2010	13	20,00	13,62	0,00	16,35	
15 April 2010	14	20,00	14,53	0,00	17,15	
16 April 2010	15	20,00	14,78	0,00	17,36	
17 April 2010	16	20,00	15,32	0,00	17,55	
18 April 2010	17	20,00	15,55	0,00	17,70	
19 April 2010	18	20,00	15,65	0,00	17,81	
20 April 2010	19	20,00	15,69	0,00	17,95	
21 April 2010	20	20,00	15,70	0,00	17,98	
22 April 2010	21	20,00	15,70	0,00	18,00	
23 April 2010	22	20,00	15,70	0,00	18,00	

Catatan : Konsentrasi nanofiller yang dimasukan ke dalam media air kelapa masing-masing sebesar 3% w/v.

Tabel A.5. Komposisi Kandungan Air Kelapa [48-49]

Kandungan	Rumus Kimia	Konsentrasi	Satuan
Air	H_2O	95,50%	
Gula	$C_{12}H_{22}O_{11}$	4,40%	
Natrium	Na	42	mg
Kalium	K	290	mg
Kalsium	Ca	44	mg
Magnesium	Mg	10	mg
Besi	Fe	106	mg
Tembaga	Cu	26	mg
Fospat	P	n.a.	
Klorida	Cl	n.a.	
Tanin		n.a.	
Asam Askorbat		n.a.	
Vitamin C		n.a.	
Protein		n.a.	
Lemak		n.a.	
Hidrat Arang		n.a.	

n.a. : (*not available*)

Catatan : Komposisi kandungan air kelapa dapat berbeda-beda tergantung dari jenis dan usia kelapa.

REPORT OF TESTING
Serial No. : 00…/K/KS/IV/2010

Date of Received: 26 Mei 2010 Date of Test: 26 Mei 2010
Product & Type : Biocomposite from Nata
Quantity / Size / Thickness : **16 Pcs**
(T = 0.5 - 1 mm, W =11- 12.5 mm, Gauge length = 50 mm)
Description / Condition of Sample : Pure nata and Biocomposites
Tested for : Tensile strength
Standard Test Method : ASTM D 638
Company : Sdr. Darmansyah
Address : Pascasarjana Teknik Kimia UI
Technician : Ismadi, Masruchin

TEST RESULT:

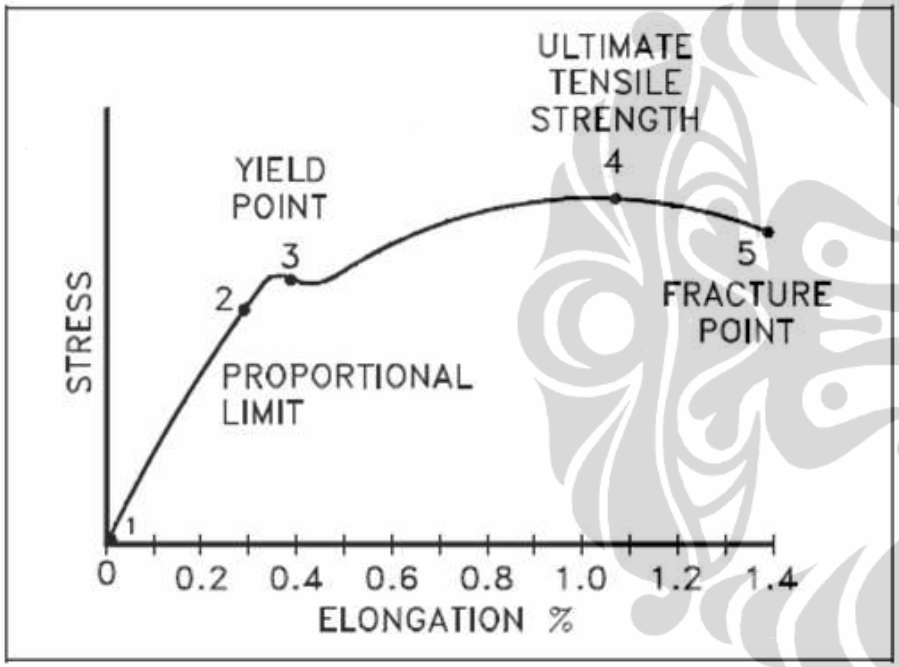
No	Code Sample	Max Force (N)	Max Strain (%)	Elongation at Break (%)	Tensile Strength (MPa)	Tensile Modulus (MPa)
1	**SiO_2-EP-1**	28.797	2.620	5.19	4.21	914.89
2	**SiO_2-EP-2**	19.062	1.104	7.826	2.81	355.72
3	**Al_2O_3-EP-1**	93.016	5.758	6.082	12.98	1456.85
4	**Al_2O_3-EP-2**	67.922	1.810	1.904	11.79	2171.07
5	**Clay-EP-1**	49.906	2.134	3.294	8.36	620.95
6	**Clay-EP-2**	69.172	3.000	4.790	10.97	771.23
7	**SiO_2-VE-1**	219.938	5.864	5.924	19.81	1301.92
8	**SiO_2-VE-2**	157.625	4.698	4.730	15.02	954.85
9	**Al_2O_3-VE-1**	121.781	4.528	4.574	11.02	1025.7
10	**Al_2O_3-VE-2**	217.750	6.368	6.368	21.02	903.68
11	**Clay-VE-1**	317.344	8.646	8.692	27.42	1687.37
12	**Clay-VE-2**	305.078	7.278	7.282	27.53	957.65
13	**SiO_2-PE-1**	179.609	10.558	10.568	16.27	619.83
14	**SiO_2-PE-2**	81.0938	2.054	2.918	7.00	690.96
15	**Al_2O_3-PE-1**	125.438	7.144	7.182	10.07	375.65
16	**Al_2O_3-PE-2**	106.813	7.754	11.888	8.84	245.22
17	**Clay-PE-1**	193.641	8.972	8.976	15.59	590.95
18	**Clay-PE-2**	84.0938	2.666	2.792	7.76	562.89
19	**SiO_2 BC-1**	218.969	15.816	15.824	230.86	2760.87
20	**SiO_2 BC-2**	172.625	14.890	17.104	179.35	2130.97
21	**Al_2O_3 BC-1**	143.922	10.992	10.992	177.43	2677.54
22	**Al_2O_3 BC-2**	62.4063	5.500	5.746	57.53	1617.01
23	**Clay BC-1**	156.469	14.613	14.744	128.31	2709.98
24	**Clay BC-2**	135.922	10.976	10.982	128.42	3920.38
25	**Epoxy-1**	1169.22	5.012	6.046	21.00	1523.52

No	Code Sample	Max Force (N)	Max Strain (%)	Elongation at Break (%)	Tensile Strength (MPa)	Tensile Modulus (MPa)
26	**Epoxy-2**	895.625	7.674	8.112	16.27	1075.54
27	**Vinil Ester-1**	458.906	7.581	7.848	13.31	451.803
28	**Vinil Ester-2**	906.094	8.372	8.378	29.35	1457.89
29	**Poliester-1**	923.281	9.748	9.788	25.79	1200.08
30	**Poliester-2**	857.344	9.174	10.978	25.24	1520.07
31	**Pure Nata-1**	79.750	5.842	5.856	159.50	7888.1
32	**Pure Nata-2**	143.469	11.744	11.750	390.39	11198.4

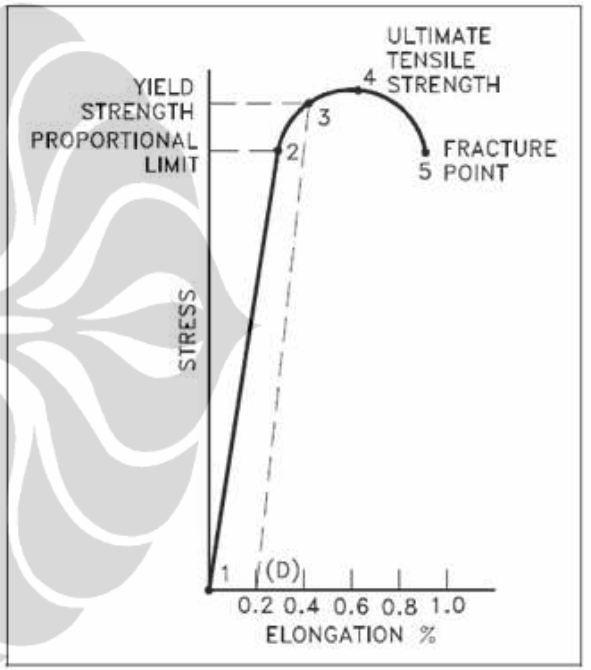
Keterangan :

EP – 1 : Epoksi untuk sampel ke-1
EP – 2 : Epoksi untuk sampel ke-2
VE – 1 : Vinil Ester untuk sampel ke-1
VE – 2 : Vinil Ester untuk sampel ke-2
PE – 1 : Poliester untuk sample ke-1
PE – 2 : Poliester untuk sample ke-2

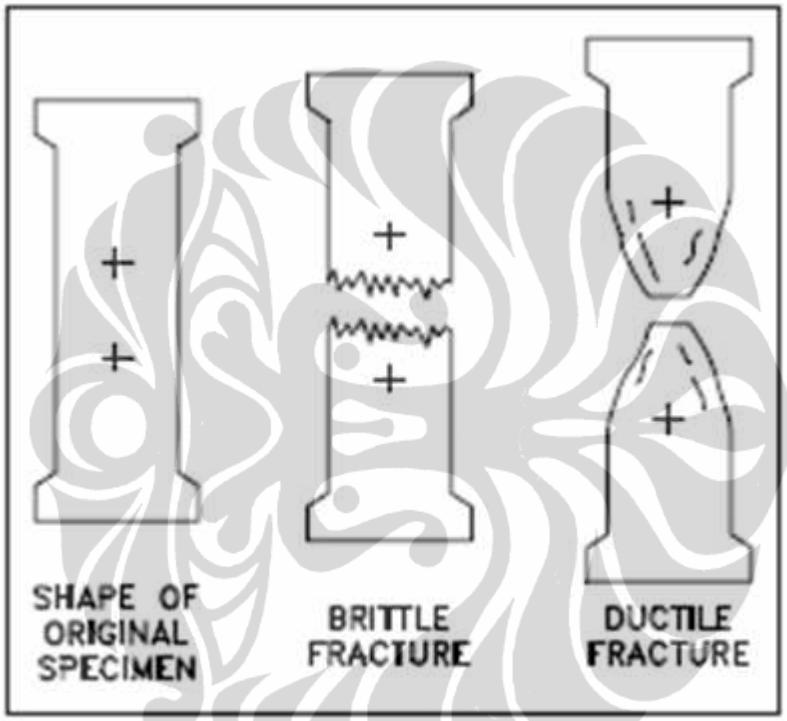
A. Kurva *Stress-Strain* Material Tipe *Ductile* dan *Brittle*



Gambar A.1 Kurva *Stress-Strain* Material Tipe *Ductile* [50]

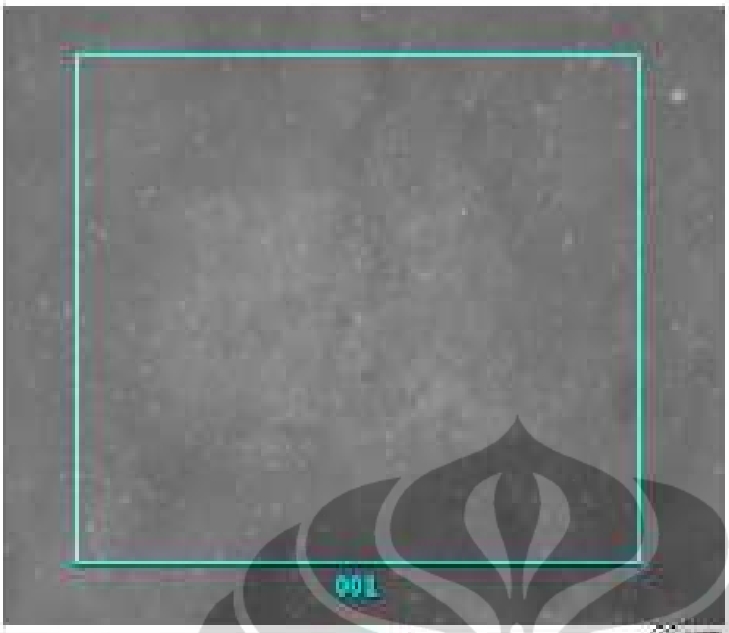


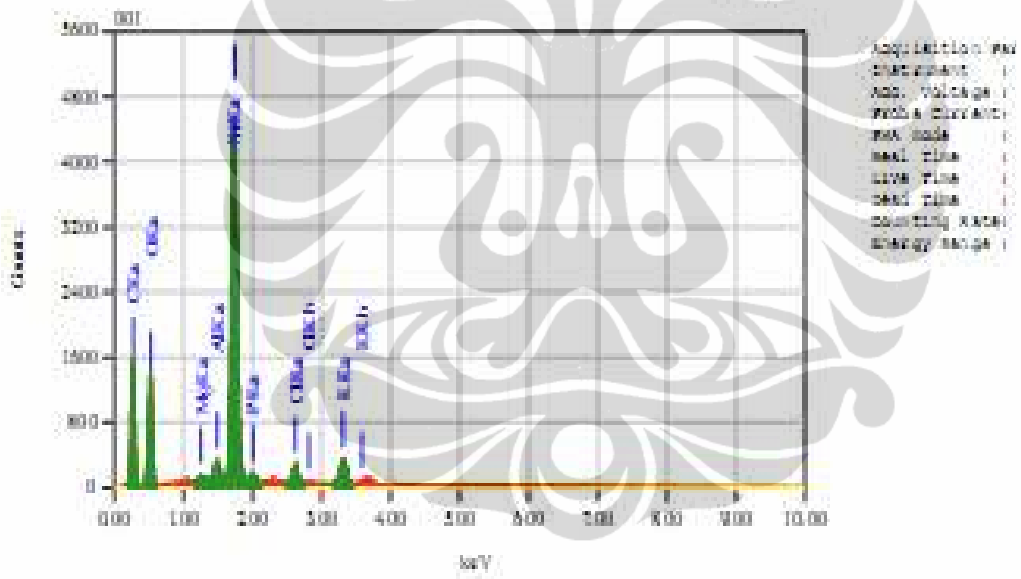
Gambar A.2 Kurva *Stress-Strain* Material Tipe *Brittle* [50]



Gambar A.3 *Basic Fracture Types* [50]

A

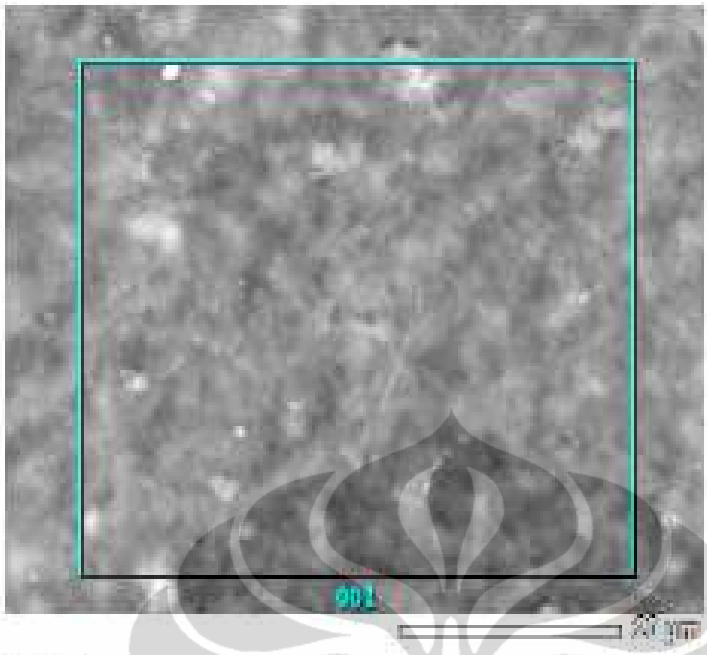


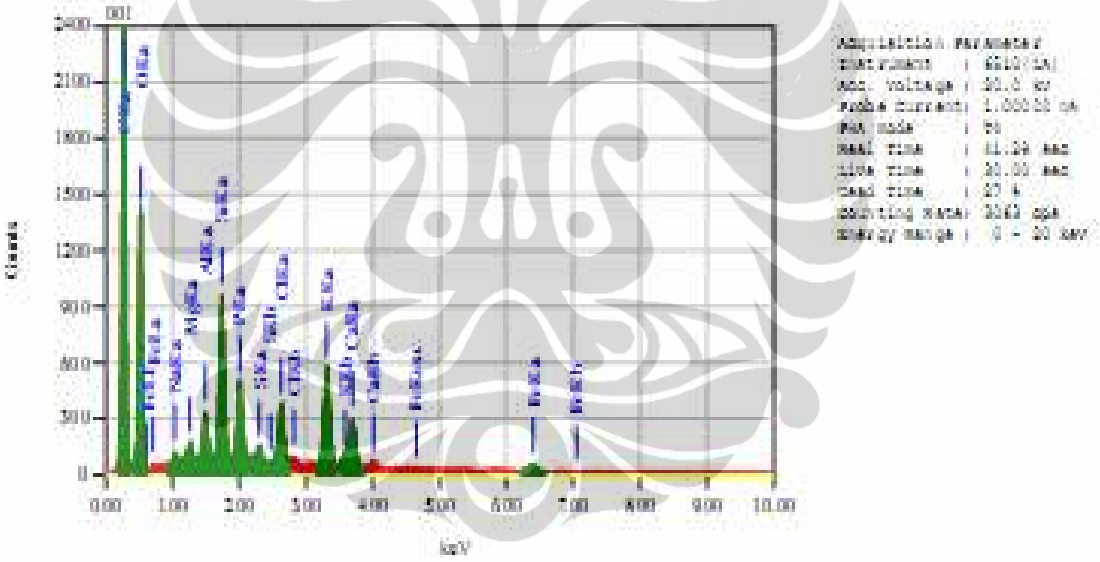


ZAF Method Standardless Quantitative Analysis
Fitting Coefficient : 0.2494

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cati
C K	0.277	44.55	0.11	56.20			
O K	0.525	35.00	0.29	33.15			
Mg K*	1.253	0.23	0.09	0.14			
Al K	1.486	0.90	0.09	0.51			
Si K	1.739	16.06	0.08	8.67			
P K*	2.013	0.39	0.10	0.19			
Cl K	2.621	1.13	0.09	0.48			
K K	3.312	1.71	0.11	0.66			
Total		100.00		100.00			

B





ZAF Method Standardless Quantitative Analysis
Fitting Coefficient : 0.2701

Element	(keV)	Mass%	Error%	Atom%	Compound	Mass%	Cation	K
C K	0.277	46.77	0.09	57.56				32.1724
O K	0.525	38.97	0.36	36.00				37.7060
Na K	1.041	0.41	0.16	0.26				0.5878
Mg K	1.253	0.43	0.12	0.26				0.5588
Al K	1.486	0.99	0.11	0.54				1.5564
Si K	1.739	3.24	0.10	1.70				6.0343
P K	2.013	2.01	0.10	0.96				4.7169
S K	2.307	0.41	0.09	0.19				0.9538
Cl K	2.621	1.47	0.10	0.61				3.4521
K K	3.312	3.03	0.13	1.15				7.0994
Ca K	3.690	1.62	0.15	0.60				3.8894
Fe K	6.398	0.65	0.36	0.17				1.2726
Total		100.00		100.00				

Beckman COULTER

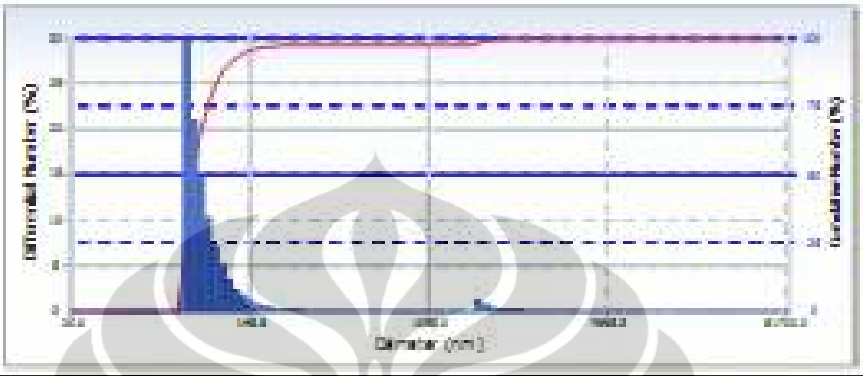
Delsa™ Nano
Common

Number Distribution S/N :

User	: Common	Group	: Kimia LIPI	Repetition	: 1/1
Date	: 7/5/2010	File Name	: Kimia_LIPI_20100705_140813		
Time	: 14:09:13	Sample Information	: SiO2		
SOP Name	: PTPM			Security	: No Security

Version 2.31.0.2.00

Number Distribution



Distribution Results(Cont.)

Peak	Diameter(nm)	Std. Dev.
1	86.6	22.3
2	2137.6	441.1
3	0.0	0.0
4	0.0	0.0
5	0.0	0.0
Average	137.2	326.6

Residual : 2.409e+012 (%/C)

Cumulants Results

Diameter	(d)	: 1812.5	(nm)
Polydispersity Index	(PDI)	: 0.627	
Diffusion Coef.	(D)	: 2.714e-009	(cm²/sec)

Measurement Condition

Temperature	: 25.0	(°C)
Dispers. Name	: WATER	
Refractive Index	: 1.3329	
Viscosity	: 0.8878	(cP)
Scattering Intensity	: 9013	(cps)

Number Distribution Table

d(nm)	f(%)	f(cum.%)	d(nm)	f(%)	f(cum.%)	d(nm)	f(%)	f(cum.%)	d(nm)	f(%)	f(cum.%)
20.0	0.0	0.0	145.5	1.0	98.5	1059.0	0.0	97.5	7698.3	0.0	100.0
21.7	0.0	0.0	157.5	0.7	99.2	1146.4	0.0	97.5	8331.0	0.0	100.0
23.4	0.0	0.0	170.6	0.5	99.7	1240.0	0.0	97.5	9019.2	0.0	100.0
25.4	0.0	0.0	184.6	0.3	99.9	1342.5	0.0	97.5	9764.2	0.0	100.0
27.5	0.0	0.0	199.8	0.2	97.2	1453.4	0.0	97.5	10570.7	0.0	100.0
29.7	0.0	0.0	216.3	0.1	97.3	1573.4	0.0	97.5	11443.9	0.0	100.0
32.2	0.0	0.0	234.2	0.1	97.4	1703.4	0.0	97.5	12389.2	0.0	100.0
34.9	0.0	0.0	253.5	0.1	97.4	1844.1	0.9	98.5	13412.6	0.0	100.0
37.7	0.0	0.0	274.5	0.0	97.5	1996.4	0.6	99.0	14520.5	0.0	100.0
40.9	0.0	0.0	297.2	0.0	97.5	2161.3	0.4	99.4	15720.0	0.0	100.0
44.2	0.0	0.0	321.7	0.0	97.5	2339.6	0.2	99.6	17018.5	0.0	100.0
47.9	0.0	0.0	348.3	0.0	97.5	2533.1	0.1	99.8	18424.2	0.0	100.0
51.8	0.0	0.0	377.0	0.0	97.5	2742.4	0.1	99.9	19946.1	0.0	100.0
56.1	0.0	0.0	408.2	0.0	97.5	2969.9	0.1	99.9	21593.8	0.0	100.0
60.8	0.0	0.0	441.9	0.0	97.5	3214.1	0.0	99.9	23377.5	0.0	100.0
65.8	0.0	0.0	478.4	0.0	97.5	3479.6	0.0	100.0	25308.9	0.0	100.0
71.2	29.8	29.8	517.9	0.0	97.5	3767.1	0.0	100.0	27399.1	0.0	100.0
77.1	20.9	50.8	560.7	0.0	97.5	4078.2	0.0	100.0	29662.3	0.0	100.0
83.5	14.6	65.4	607.0	0.0	97.5	4415.1	0.0	100.0	32112.6	0.0	100.0
90.4	10.2	75.6	657.2	0.0	97.5	4779.8	0.0	100.0	34765.1	0.0	100.0

D(10%) : 67.6 (nm) D(50%) : 76.9 (nm) D(90%) : 112.7 (nm)

Number Distribution Table

d (nm)	f(%)	f(cum.%)	d (nm)	f(%)	f(cum.%)	d (nm)	f(%)	f(cum.%)	d (nm)	f(%)	f(cum.%)
97.8	7.0	82.6	711.5	0.0	97.5	5174.6	0.0	100.0	37636.9	0.0	100.0
105.9	4.8	87.4	770.2	0.0	97.5	5602.1	0.0	100.0	40745.8	0.0	100.0
114.6	3.3	90.7	833.8	0.0	97.5	6064.8	0.0	100.0	44111.5	0.0	100.0
124.1	2.2	93.0	902.7	0.0	97.5	6565.8	0.0	100.0	47755.3	0.0	100.0
134.4	1.5	94.5	977.3	0.0	97.5	7108.2	0.0	100.0	51700.0	0.0	100.0