



LAMPIRAN 1
DATA *CHECK SHEET* DAN HASIL UJI BOCOR PADA
PROSES PENGECORAN *CYLINDER HEAD*

CHECK SHEET (19 september 2007)

Temp melting : 810 °C
 Komposisi Grain refiner : 0,12%
 Temp. penambahan grain refiner : 760 °C
 Jenis Grain Refiner : Flux/serbuk pink
 Waktu GBF : 8 menit

No Part	
1	Kiri
2	Kanan

No shot	No Part	Temp Dies		Temp molten	Tekanan mesin	Jam ke	Jenis cacat	Marking	Uji Bocor
		(°C)	(°C)	(°C)	(kg/cm ²)				
1	1	214	184	704					
	2	315	376	704					
2	3	TRIAL							
	4								
3	5	270,5	207,8	704	250	0	cacat kotor	EA	
	6	354,4	375,6				ok!	EB	
4	7	264,7	211,9	704	250	1	ok!	EE	
	8	343,9	368,5				ok!	EF	
5	9	265,2	218,7	705	250	1	ok!	E1A	
	10	348,4	363,2				ok!	E1B	
6	11	263,1	223,3	706	250	1	ok!	E1E	
	12	349,6	364,4				ok!	E1F	
7	13	261,4	221,9	707	250	1	ok!	E1G	
	14	347,3	361,5				ok!	E1H	
8	15	264,7	231,8	708	250	1	ok!	E1I	ya
	16	367,8	376,1				ok!	E1J	
9	17	265,5	234,6	707	250	1	ok!	E1K	
	18	367,7	384,0				ok!	E1L	
10	19	273,2	244,0	707	250	1	ok!	E1M	
	20	362,8	379,8				ok!	E1N	ya
11	21	274,8	249,4	708	250	1	ok!	E1O	
	22	379,1	388,2				ok!	E1P	
12	23	TRIAL/STIRAHAT		708	250	1	ok!	E1Q	
	24						ok!	E1R	
13	25	229	221	706	256	2	ok!	E2A	
	26	316	320				ok!	E2B	
14	27	228	221	707	256	2	ok!	E2E	
	28	328	352				ok!	E2F	ya
15	29	236	229	707	256	3	ok!	E3A	
	30	227	333				ok!	E3B	ya
16	31	235	227	707	256	3	ok!	E3E	
	32	346	363				ok!	E3F	
17	33	241	235	707	256	3	Aus Misrun	E3G	
	34	350	372				ok!	E3H	ya
18	35	250	239	708	256	3	ok!	E3I	
	36	340	349				ok!	E3J	ya
19	37	253	246	708	256	3	ok!	E3K	
	38	361	376				ok!	E3L	
20	39	254	247	708	256	3	ok!	E3M	ya
	40	354	366				ok!	E3N	ya
21	41	259	253	708	256	3	ok!	E3O	
	42	364	379				ok!	E3P	ya
22	43	261	255	709	256	3	ok!	E3Q	
	44	366	383				ok!	E3R	
23	45	264	259	709	256	3	ok!	E3S	ya
	46	376	395				ok!	E3T	ya

24	47	265	261	709	256	3	ok!	E3U	
	48	370	388				ok!	E3V	
25	49	266	269	709	256	3	ok!	E3W	
	50	369	390				ok!	E3X	ya
26	51	269	268	709	256	3	ok!	E3Y	ya
	52	375	394				ok!	E3Z	ya
27	53	269	270	709	262	3	ok!	E31	
	54	378	405				ok!	E32	ya
28	55	271	270	710	262	4	ok!	E4A	
	56	386	404				ok!	E4B	ya
29	57	272	271	710	262	4	ok!	E4E	ya
	58	386	390				ok!	E4F	ya
30	59	268	266	709	262	4	ok!	E4G	
	60	366	381				ok!	E4H	ya
31	61	273	271	709	262	4	ok!	E4I	
	62	380	404				ok!	E4J	
32	63	275	272	709	262	4	ok!	E4K	ya
	64	382	407				ok!	E4L	ya
33	65	247	245	708	262	4	ok!	E4M	
	66	337	346				ok!	E4N	
34	67	259	253	708	262	4	ok!	E4O	
	68	355	362				ok!	E4P	ya
35	69	276	266	707	262	4	ok!	E4Q	
	70	368	391				ok!	E4R	ya
36	71	274	269	708	262	4	ok!	E4S	
	72	374	396				ok!	E4T	ya
37	73	275	270	708	262	4	ok!	E4U	
	74	375	400				ok!	E4V	
38	75	stop produksi 15:06							
	76								

Dari 72 buah *cylinder head* yang diproduksi ternyata hanya ada 24 buah *cylinder head* yang lolos inspeksi. Hal ini dikarenakan 48 buah *cylinder head* ditemukan banyak cacat. Hal ini terjadi karena pemakaian *dies* yang dimensinya tidak baik. Dari 24 buah *cylinder head* yang dilakukan uji bocor, ada 2 buah *cylinder head* yang mengalami bocor.

LAMPIRAN 2
PENGUJIAN KOMPOSISI



(Komposisi pada 0 jam)



CENTER FOR MATERIALS PROCESSING AND FAILURE ANALYSIS
DEPARTEMEN TEKNIK METALURGI & MATERIAL-UNIVERSITAS INDONESIA

LABORATORIUM UJI MATERIAL

Kampus Baru UI – Depok 16424 – Indonesia
Phone : 021 – 788 49045, 786 3510 Fax : 021 – 787 2350 E-mail : cmpfa@metal.ui.ac.id

LAPORAN PENGUJIAN KOMPOSISI KIMIA
COMPOSITION TEST REPORT

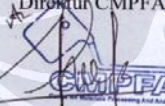

Hal 1 dari 2

No Laporan <i>Report Nr</i>	0539	Bahan <i>Material</i>	Al alloy
Pemakai Jasa <i>Customer</i>	Kaspar Purba	Identitas Bahan <i>Material Identity</i>	0.12%
Alamat <i>Address</i>	-	Tanggal Terima <i>Receiving Date</i>	3 Juni 2008
No Kontrak <i>Contract Nr.</i>	0539/PT.02/FT04/P/2008	Standar <i>Standard</i>	ASTM A751
Tanggal Uji <i>Date of Test</i>	6 Juni 2008	Mesin Uji <i>Testing machine</i>	Emission Spectrometer

Kode Sampel <i>Sample Code</i>	Al (%)	Si (%)	Fe (%)	Cu (%)	Mn (%)	Mg (%)	Zn (%)
0.12%	85.9	9.40	0.786	2.80	0.308	0.172	0.319
	Ni (%)	Ti (%)	Pb (%)	V (%)	Zr (%)	Ga (%)	Co (%)
	0.0547	0.0795	0.0834	0.0104	0.0046	0.0129	0.0169

Depok, 10 Juni 2008
LABORATORIUM UJI MATERIAL

Diruktur CMPFA,



(Dwi Marta Nurjaya ST, MT)

Laporan hasil pengujian ini hanya berlaku untuk sampel yang diuji di Laboratorium Uji Material ; publikasi serta penggunaan dokumen ini atau sebagian dari padanya harus dengan izin dari Laboratorium Uji Material

(Komposisi pada 4 jam)



Department of Metallurgy and Materials Engineering
UNIVERSITY OF INDONESIA

CHEMICAL COMPOSITION TEST REPORT

Contract No. / No. Kontrak 597

Standards / Standar : ASTM A751

Customer / Pemberi Kerja :

Materials / Material : 0.12%

	Al	Si	Fe	Cu	Mn	Mg	Zn	Cr
1	85.8	9.37	0.892	2.75	0.316	0.199	0.330	< 0.0010
2	86.0	9.35	0.844	2.72	0.302	0.175	0.304	< 0.0010
3	85.7	9.55	0.894	2.81	0.307	0.174	0.296	< 0.0010
Ave	85.9	9.42	0.876	2.76	0.309	0.183	0.310	< 0.0010

	Ni	Ti	Be	Ca	Li	Pb	Sn	Sr
1	0.0950	0.0484	< 0.0001	< 0.0005	< 0.0001	0.0710	< 0.0100	< 0.0001
2	0.0660	0.0460	< 0.0001	< 0.0005	< 0.0001	0.0587	< 0.0100	< 0.0001
3	0.0733	0.0466	< 0.0001	< 0.0005	< 0.0001	0.0611	< 0.0100	< 0.0001
Ave	0.0781	0.0470	< 0.0001	< 0.0005	< 0.0001	0.0636	< 0.0100	< 0.0001

	V	Na	Bi	Zr	B	Ga	Cd	Co
1	0.0088	< 0.0005	< 0.0050	0.0056	0.0014	0.0115	0.0024	< 0.0030
2	0.0083	< 0.0005	< 0.0050	0.0049	0.0005	0.0119	0.0019	< 0.0030
3	0.0089	< 0.0005	< 0.0050	0.0058	0.0010	0.0123	0.0028	< 0.0030
Ave	0.0087	< 0.0005	< 0.0050	0.0055	0.0009	0.0119	0.0024	< 0.0030

	Ag	Hg	In
1	0.0030	< 0.0030	< 0.0100
2	0.0018	< 0.0030	< 0.0100
3	0.0023	< 0.0030	< 0.0100
Ave	0.0024	< 0.0030	< 0.0100

Datum / date
6/17/2008

Tested by / Diuji oleh :
Deni

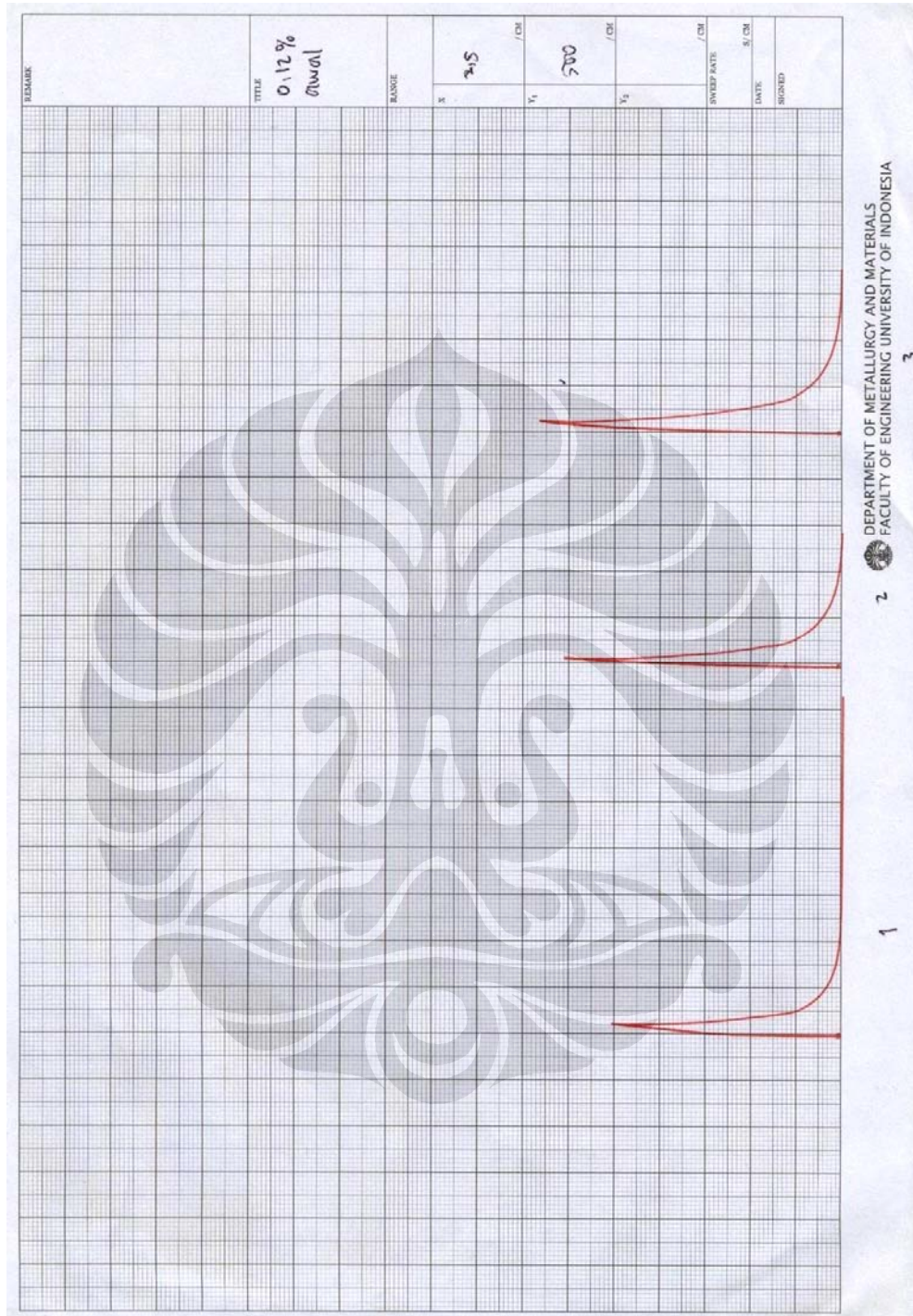
Approved by / Disetujui oleh :
Jaya

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e-mail: cmpfa@metal.ui.ac.id

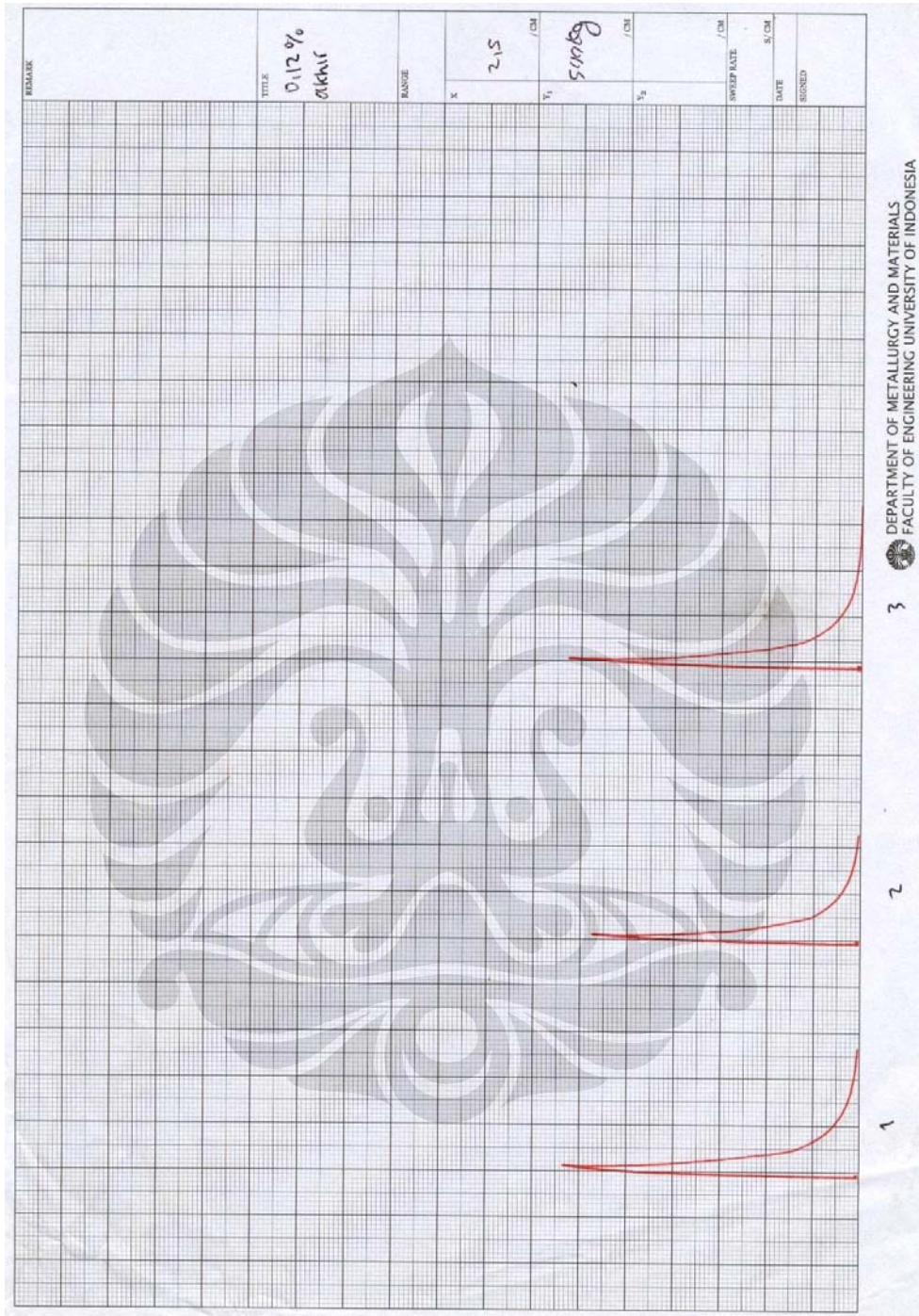
LAMPIRAN 3
PENGUJIAN TARIK



(Grafik uji tarik pada 0 jam)



(Grafik uji tarik pada 4 jam)



Pengolahan Data Hasil Grafik Uji Tarik

0,12%	Sampel	F(N)	A(mm ²)	UTS	rata UTS	stdev	error	gauge length	Δl cm	elongasi (%)	rt elongasi
awal	1	25000	174,3	143,5	165,8 MPa	2,07	0,12	5 cm	0,7	1,4	1,2
	2	30000	176,6	169,9				5 cm	0,5	1	
	3	33000	179,0	184,4				5 cm	0,6	1,2	
akhir	1	31500	186,2	169,2	162,9 MPa	0,86	0,05	5 cm	0,5	1	1
	2	28500	186,2	153,1				5 cm	0,5	1	
	3	31000	186,2	166,5				5 cm	0,5	1	

LAMPIRAN 4
PENGUJIAN KEKERASAN



(Sampel Bagian Tebal)

	Titik	d1	d2	(d1+d2)/2	BHN
Jam ke - 1	1	0,654	0,642	0,648	93,79
	2	0,671	0,681	0,676	86,10
	3	0,662	0,660	0,661	90,10
	4	0,676	0,671	0,674	86,75
	5	0,651	0,658	0,655	91,92
				Rata-rata	89,7
				Stdev	3,29
				Error	0,04

	Titik	d1	d2	(d1+d2)/2	BHN
Jam ke - 2	1	0,685	0,678	0,682	84,70
	2	0,695	0,696	0,696	81,28
	3	0,648	0,656	0,652	92,63
	4	0,636	0,641	0,639	96,63
	5	0,685	0,682	0,684	84,20
				Rata-rata	87,9
				Stdev	6,45
				Error	0,07

	Titik	d1	d2	(d1+d2)/2	BHN
Jam ke - 3	1	0,686	0,681	0,684	84,20
	2	0,656	0,663	0,660	90,51
	3	0,679	0,673	0,676	86,10
	4	0,656	0,660	0,658	90,93
	5	0,682	0,683	0,686	84,45
				Rata-rata	87,2
				Stdev	3,26
				Error	0,04

	Titik	d1	d2	(d1+d2)/2	BHN
Jam ke - 4	1	0,670	0,662	0,666	88,74
	2	0,680	0,700	0,690	82,60
	3	0,676	0,667	0,672	87,27
	4	0,630	0,631	0,631	99,13
	5	0,673	0,663	0,668	88,20
				Rata-rata	89,2
				Stdev	6,06
				Error	0,07

(Sampel Bagian Tipis)

	Titik	d1	d2	(d1+d2)/2	BHN
Jam ke - 1	1	0,652	0,658	0,655	91,78
	2	0,667	0,658	0,663	89,69
	3	0,657	0,658	0,658	91,07
	4	0,657	0,668	0,663	89,69
	5	0,669	0,667	0,668	88,20
				Rata-rata	90,1
				Stdev	1,38
				Error	0,02

	Titik	d1	d2	(d1+d2)/2	BHN
Jam ke - 2	1	0,677	0,680	0,679	85,46
	2	0,670	0,666	0,668	88,20
	3	0,666	0,661	0,664	89,41
	4	0,629	0,626	0,628	100,08
	5	0,676	0,674	0,675	86,35
				Rata-rata	89,9
				Stdev	5,89
				Error	0,06

	Titik	d1	d2	(d1+d2)/2	BHN
Jam ke - 3	1	0,654	0,662	0,658	90,93
	2	0,657	0,647	0,652	92,63
	3	0,651	0,653	0,652	92,63
	4	0,668	0,667	0,667	88,33
	5	0,647	0,652	0,650	93,35
				Rata-rata	91,6
				Stdev	2,02
				Error	0,02

	Titik	d1	d2	(d1+d2)/2	BHN
Jam ke - 4	1	0,665	0,662	0,664	89,41
	2	0,644	0,647	0,646	94,53
	3	0,648	0,651	0,649	93,35
	4	0,644	0,630	0,637	97,09
	5	0,657	0,663	0,660	90,37
				Rata 2	92.9
				Stdev	3.12
				Error	0.03

LAMPIRAN 5
PERHITUNGAN JARAK DAS



(Sampel Bagian Tebal)

Jam ke-1	
Titik	DAS (μm)
1	22,24
2	22,24
3	22,24
4	22,24
5	16,68
6	22,24
7	18,90
8	21,13
9	22,24
10	22,24
Rata-rata	21,2
Stdev	1,92
Error	0,09

Jam ke-2	
Titik	DAS (μm)
1	23,35
2	23,35
3	21,13
4	24,46
5	23,35
6	22,24
7	21,13
8	26,69
9	22,24
10	22,24
Rata-rata	23,0
Stdev	1,66
Error	0,07

Jam ke-3	
Titik	DAS (μm)
1	28,91
2	23,35
3	22,24
4	22,24
5	23,35
6	22,24
7	23,35
8	24,46
9	22,24
10	22,24
Rata-rata	23,5
Stdev	2,06
Error	0,09

Jam ke-4	
Titik	DAS (μm)
1	22,24
2	21,13
3	22,24
4	17,79
5	21,13
6	21,13
7	21,13
8	22,24
9	21,13
10	21,13
Rata-rata	21,1
Stdev	1,28
Error	0,06

(Sampel Bagian Tipis)

Jam ke-1	
Titik	DAS (μm)
1	15,01
2	13,90
3	13,34
4	13,90
5	13,90
6	15,01
7	12,23
8	13,34
9	13,90
10	12,79
Rata-rata	13,73
Stdev	0,87
Error	0,06

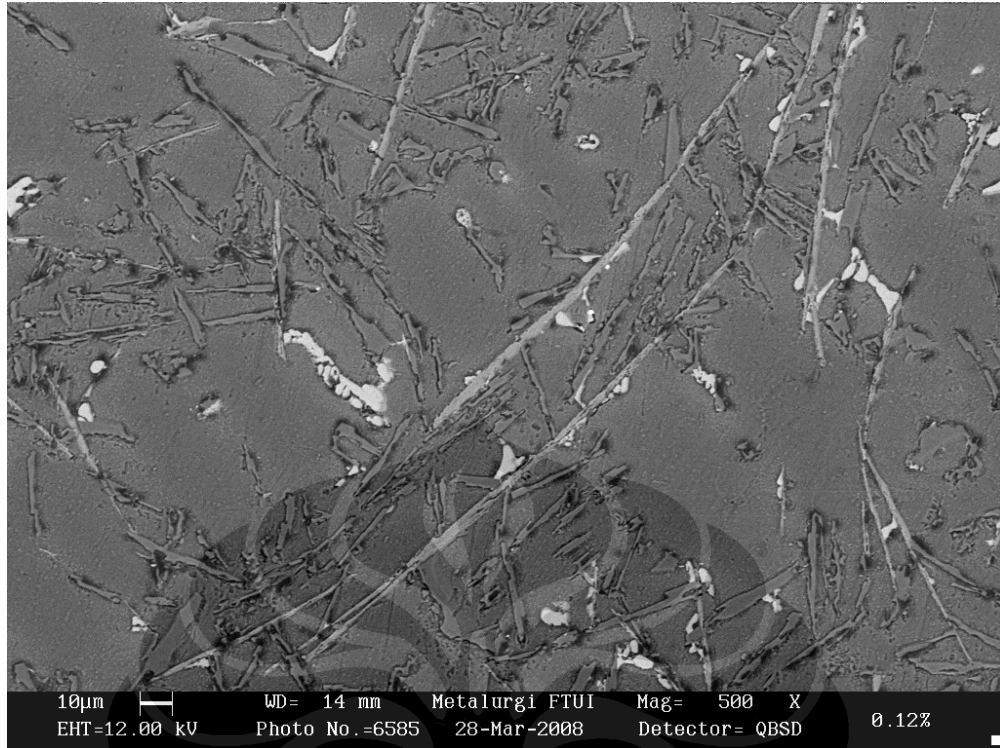
Jam ke-2	
Titik	DAS (μm)
1	13,90
2	14,46
3	13,90
4	15,01
5	15,01
6	14,46
7	16,12
8	16,68
9	16,68
10	13,90
Rata-rata	14,95
Stdev	1,19
Error	0,08

Jam ke-3	
Titik	DAS (μm)
1	12,79
2	11,68
3	11,68
4	13,34
5	12,23
6	12,79
7	12,79
8	13,90
9	12,23
10	13,40
Rata-rata	12,68
Stdev	0,73
Error	0,06

Jam ke-4	
Titik	DAS (μm)
1	11,12
2	13,34
3	11,12
4	10,00
5	11,12
6	12,23
7	11,12
8	10,00
9	11,12
10	12,23
Rata-rata	11,34
Stdev	1,023
Error	0,09

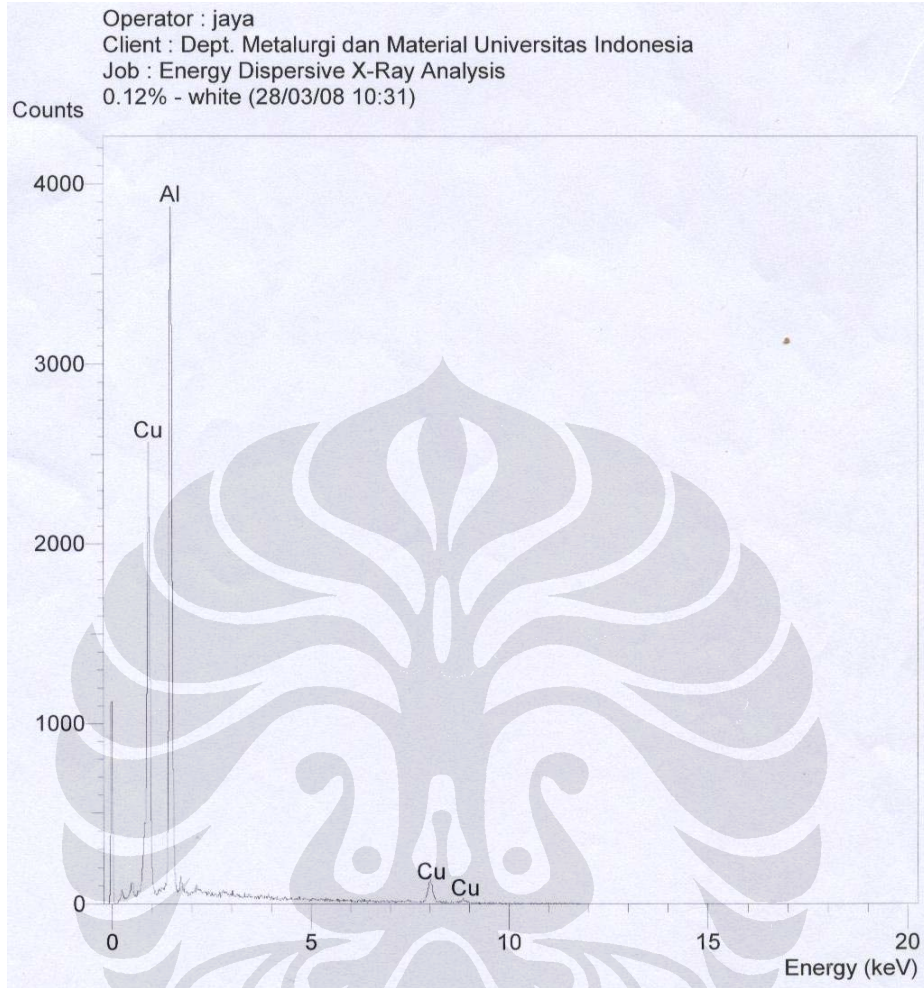
LAMPIRAN 6
HASIL PENGAMATAN SEM DAN EDS





Hasil SEM pada AC4B dengan penambahan 0,05 wt. % Ti. Perbesaran 500 x

(White)



SEMQuant results. Listed at 10:32:14 on 28/03/08
Operator: jaya
Client: Dept. Metalurgi dan Material Universitas Indonesia
Job: Energy Dispersive X-Ray Analysis
Spectrum label: 0.12% - white

System resolution = 60 eV

Quantitative method: ZAF (3 iterations).
Analysed all elements and normalised results.

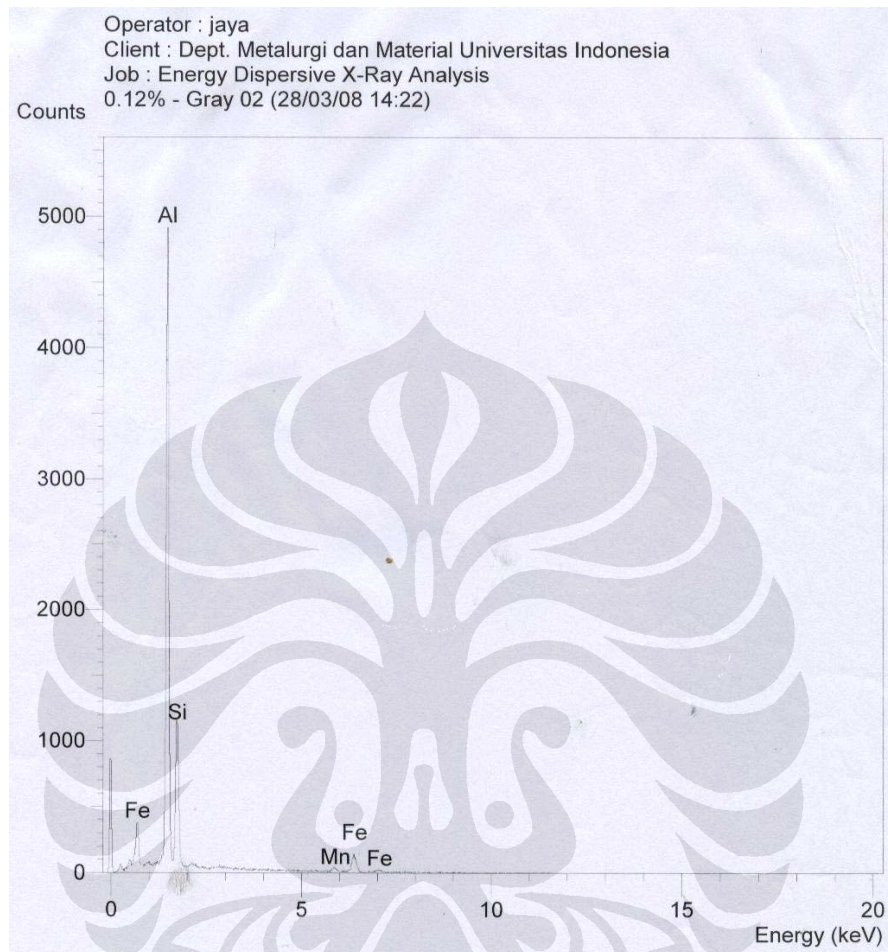
4 peaks possibly omitted: -0.02, 0.24, 0.48,
2.82 keV

Standards :
Al K CeAl2 03/03/07
Cu K Copper 22/03/06

Elmt	Spect. Type	Element %	Atomic %
Al K	ED	33.13	53.85
Cu K	ED	66.87	46.15
Total		100.00	100.00

* = <2 Sigma

(Grey)



SEMQuant results. Listed at 14:23:32 on 28/03/08
Operator: jaya
Client: Dept. Metalurgi dan Material Universitas Indonesia
Job: Energy Dispersive X-Ray Analysis
Spectrum label: 0.12% - Gray 02

System resolution = 62 eV

Quantitative method: ZAF (3 iterations).
Analysed all elements and normalised results.

3 peaks possibly omitted: -0.02, 0.24, 2.14 keV

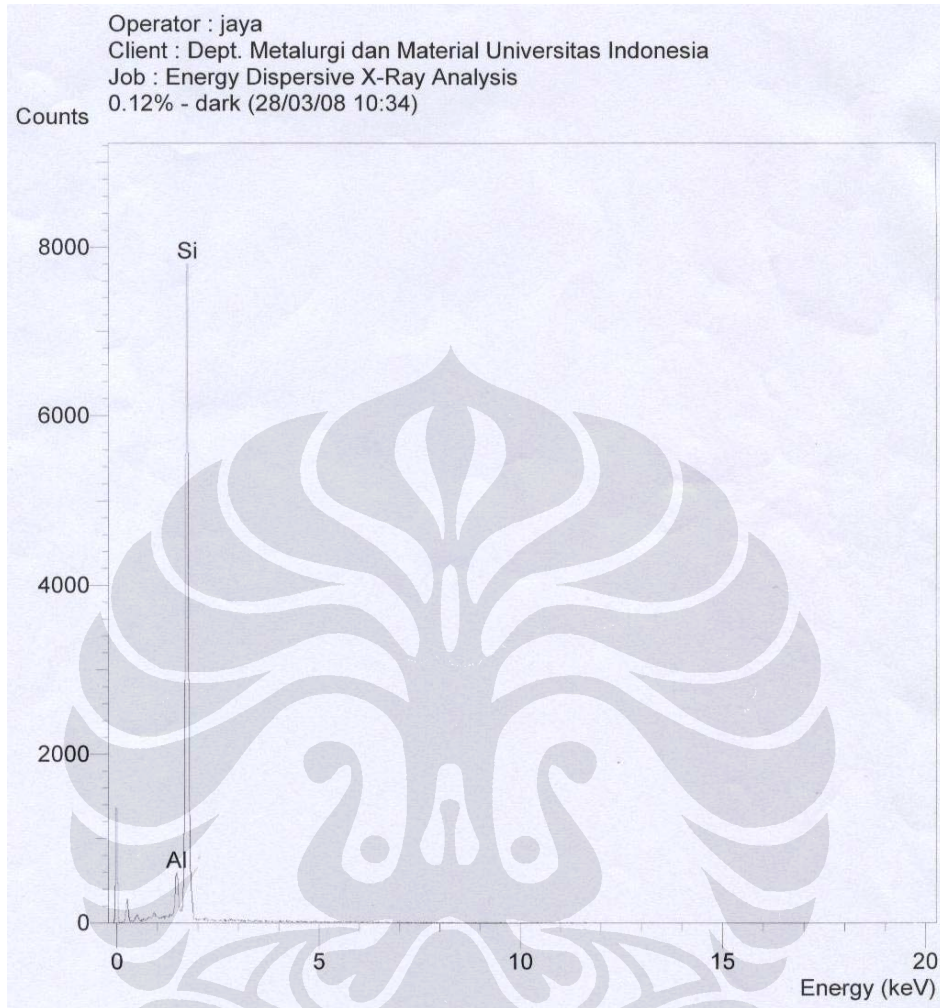
Standards :

Al K	CeAl2	03/03/07
Si K	Low Carbon Steel	13/09/06
Mn K	Mangan 02	13/09/06
Fe K	FeS2	22/03/06

Elmt	Spect. Type	Element %	Atomic %
Al K	ED	58.50	68.83
Si K	ED	13.41	15.15
Mn K	ED	4.45	2.57
Fe K	ED	23.64	13.44
Total		100.00	100.00

* = <2 Sigma

(Dark)



SEMQuant results. Listed at 10:35:15 on 28/03/08
Operator: jaya
Client: Dept. Metalurgi dan Material Universitas Indonesia
Job: Energy Dispersive X-Ray Analysis
Spectrum label: 0.12% - dark

System resolution = 59 eV

Quantitative method: ZAF (2 iterations).
Analysed all elements and normalised results.

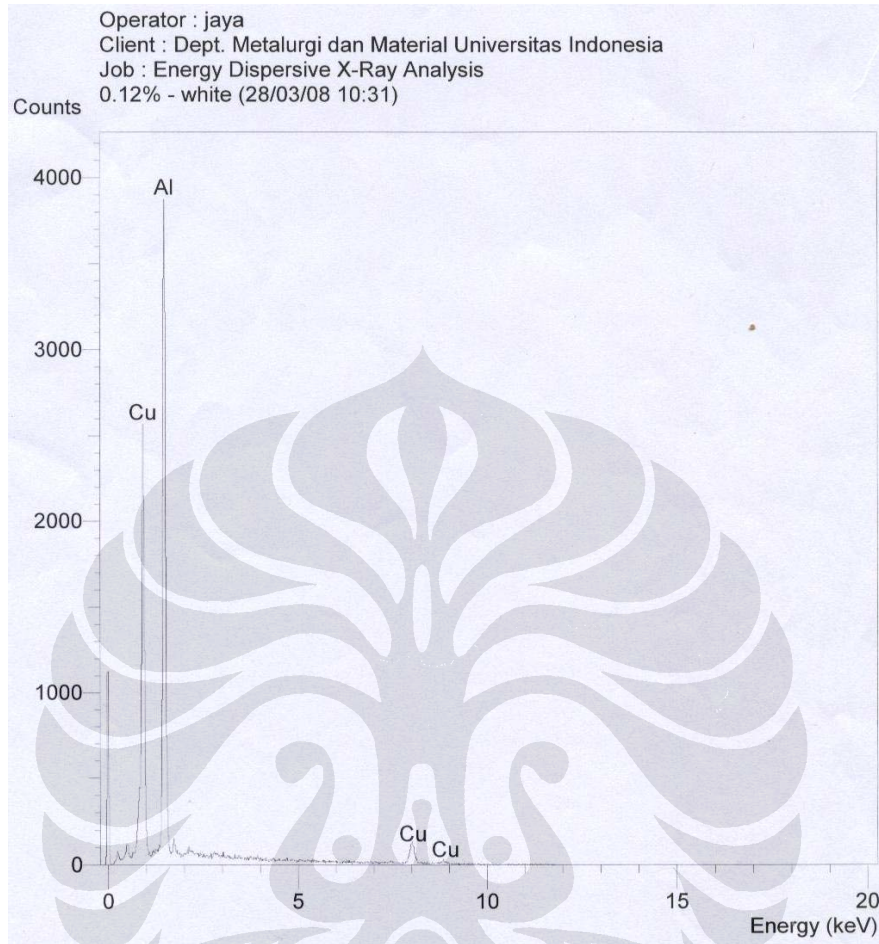
4 peaks possibly omitted: -0.02, 0.26, 0.50,
0.92 keV

Standards :
Al K CeAl2 03/03/07
Si K Low Carbon Steel 13/09/06

Elmt	Spect. Type	Element %	Atomic %
Al K	ED	7.77	8.06
Si K	ED	92.23	91.94
Total		100.00	100.00

* = <2 Sigma

(Matrix)



SEMQuant results. Listed at 10:32:14 on 28/03/08
Operator: jaya
Client: Dept. Metalurgi dan Material Universitas Indonesia
Job: Energy Dispersive X-Ray Analysis
Spectrum label: 0.12% - white

System resolution = 60 eV

Quantitative method: ZAF (3 iterations).
Analysed all elements and normalised results.

4 peaks possibly omitted: -0.02, 0.24, 0.48,
2.82 keV

Standards :

Al K CeAl2 03/03/07
Cu K Copper 22/03/06

Elmt	Spect. Type	Element %	Atomic %
Al K	ED	33.13	53.85
Cu K	ED	66.87	46.15
Total		100.00	100.00

* = <2 Sigma

LAMPIRAN 7
TABEL KONVERSI NILAI KEKERASAN

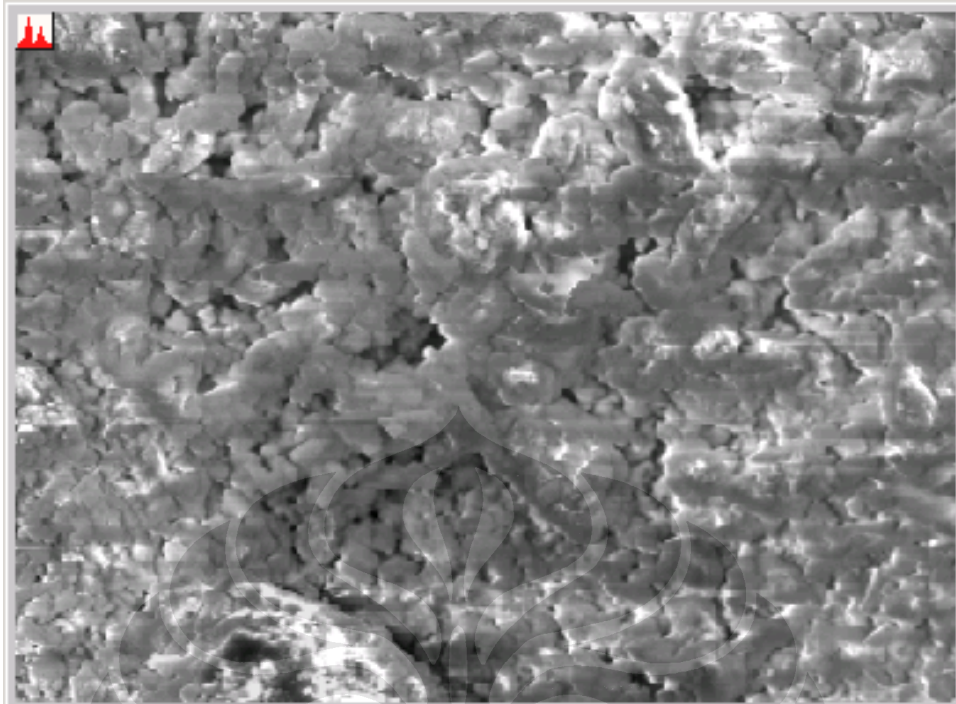


ROCKWELL SCALES														BRINELL		
A	B	C	D	E	F	G	H	K	15N	30N	45N	15T	30T	45T	BHN 500kg	BHN 3000kg
44	70			100	97	33		82				84	64	44	110	125
44	69			99	96	31		81				83	63	43	109	123
43	68			98	96	30		80				83	62	42	107	121
43	67			98	95	28		79				83	62	41	106	119
42	66			97	95	27		78				82	61	40	104	117
42	65			96	94	25		78				82	60	39	102	116
42	64			96	94	24		77				82	60	38	101	114
41	63			95	93	22		76				81	59	37	99	112
41	62			95	92	21		75				81	58	36	98	110
40	61			94	92	19		74				81	57	35	96	108
40	60			93	91	18		73				81	57	34	95	107
39	59			93	91	16		72				80	56	32	94	106
39	58			92	90	15		71				80	55	31	92	104
38	57			91	90	13		71				80	55	30	91	102
38	56			91	89	12		70				79	54	29	90	101
38	55			90	88	10		69				79	53	28	89	99
37	54			90	88	9		68				79	53	27	87	
37	53			89	87	7		67				78	52	26	86	
36	52			88	87	6		66				78	51	25	85	
36	51			88	86	4		65				78	51	24	84	
35	50			87	86	3		65				77	50	23	83	
35	49			87	85			64				77	49	22	82	
35	48			86	85			63				77	49	21	81	
34	47			85	84			62				76	48	20	80	

LAMPIRAN 8

***GRAIN REFINER* Coveral GR-2815**





Element	Class.	(keV)	mass%
B K*			
O			16.58
F K		0.677	34.51
Na K		1.041	0.55
Cl K		2.621	1.62
K K		3.312	32.03
Ti K		4.508	14.72
Total			100.00

Gambar mikrostruktur dan tabel komposisi Coveral GR berbentuk serbuk pada perbesaran 800X

Kandungannya adalah sebagai berikut :

F	= 34,15 wt. %
Na	= 0,55 wt. %
Cl	= 1,34 wt. %
K	= 32,84 wt. %
Ti	= 14,95 wt. %



Edition 01/05

Technical Data Sheet

COVERAL* GR 2815

Sodium Free Granulated Flux for Grain Refining of Aluminium and Aluminium Alloys

General description	<p>COVERAL GR 2815 is a sodium free grain refining granulated flux suitable for Aluminium and Aluminium alloys including those containing alloying amounts of magnesium. It is a universal grain refiner based on titanium and boron.</p> <p>COVERAL GR 2815 when plunged into the melt reacts to form titanium diboride and aluminium boride. These finely dispersed species are highly efficient nuclei that promote a fine equiaxed grain growth during solidification. This grain structure ensures excellent feeding characteristics leading to optimum mechanical properties in the casting. This improvement in feeding properties is beneficial in sand casting application but is of particular benefit in gravity die casting where solidification rates are usually quite high.</p>
Advantages	<p>COVERAL GR 2815 is sodium free.</p> <p>COVERAL GR 2815 is dust free in use and emits low fume during application.</p> <p>Granulated fluxes can be used at reduced application rates compared to powder fluxes.</p>
Application	<p>Any dross present on the melt surface should be carefully removed. The required amount of COVERAL GR 2815 is then placed on the melt surface and plunged to the bottom of the melt using a clean and preheated plunging tool and stirred vigorously into the melt. After the reaction is complete the melt surface should be drossed off using a suitable skimming tool.</p> <p>Any subsequent degassing by tablets or by FDU Impeller treatment can be done without any detrimental effects to the grain refining efficiency.</p>
Application temperature	700 °C and higher.
Addition rate	0.05 - 0.15 % of the metal weight, depending on alloy type.
Packing	25 Kg polyethylene lined multi-ply paper sacks.
Storage	Like all fluxes, COVERAL GR 2815 should be stored in a dry place. Close opened packages or storage bins securely after use.
Labelling	Xn Harmful.
Health and safety	<p>For safety reasons this product must be used only in accordance with the instructions for use contained in this Technical Data Sheet.</p> <p>The Material Safety Data Sheet for this product is available on request.</p>
Further remarks	<p>The data given in this leaflet are only guide values and do not represent a specification. All rights to make technical changes to improve the product are reserved.</p>

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