LAMPIRAN 1

CONTOH PERHITUNGAN SOLUBILITY PRODUCT

SOLUBILITY PRODUCT

$$\log\left[(Nb)\,x\,\left(C+\frac{12}{14}\,N\right)\right]=2.26-\frac{6770}{T}$$

$$\log\left[(0.029)\,x\,\left(0.0872+\frac{12}{14}\,0.0105\right)\right]=2.26-\frac{6770}{T}$$

$$\log[(0.029)\,x\,(0.0962)]=2.26-\frac{6770}{T}$$

$$\log[0.0027898]=2.26-\frac{6770}{T}$$

$$\log[0.0027898]=2.26-\frac{6770}{T}$$

$$-2.55=2.26-\frac{6770}{T}$$

$$\frac{6770}{T}=2.26+2.55$$

$$T=\frac{6770}{4.81}=1407\ ^{o}K=(1407-273)\ ^{o}C$$

Maka T = 1134 ^{o}C

LAMPIRAN 2

HASIL UJI KOMPOSISI

Program: FE-01
Comment: Orientation Fe-alloys 114669/02
Single spark(s)

14/03/2008 05:44:21 PI

Elements: Concentration

Batch / Lot No:
Sample/Melt No: N Check

Inspector: Q-142

Standar / Spec.:
Part No or Id: Mt 080314

No	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Co	Cu
	%	%	%	%	%	%	%	%	%	%	%
1	0.0865	0.2987	1.3268	<0.0005	<0.0003	5.4505	0.0134	0.0172	0.0284	0.0076	0.0067
2	0.0883	0.2920	1.2921	<0.0005	<0.0003	6.4583	0.0152	0.0165	0.0274	0.0075	0.0064
3	0.0867	0.2942	1.3080	<0.0005	<0.0003	5.4527	0.0128	0.0166	0.0280	0.0071	0.0065

No	Nb	Ti	V	W	Pb	Mg	Ca	Sb	Ta	B	N
	%	%	%	%	%	%	%	%	%	%	%
1	0.0296	0.0010	0.0767	0.0105	0.0018	0.0060	0.0013	<0.0010	<0.0050	<0.0005	0.0109
2	0.0284	0.0011	0.0757	<0.0100	0.0014	0.0066	0.0014	<0.0010	<0.0050	<0.0005	0.0097
3	0.0290	0.0010	0.0764	<0.0100	0.0015	0.0058	0.0013	<0.0010	<0.0050	<0.0005	0.0110

No	Fe
	%
1	92.62
2	91.66
3	92.65

Program: FE-01
Comment: Orientation Fe-alloys 114669/02
Average (n=3)

14/03/2008 05:44:25 PM

Elements: Concentration

Batch / Lot No:
Sample/Melt No: N Check

Inspector: Q-142

Standar / Spec.:
Part No or Id: Mt 080314

	C	Si	Mn	P	S	Cr	Mo	Ni	Al	Co	Cu
	%	%	%	%	%	%	%	%	%	%	%
$\bar{x}$	0.0872	0.2950	1.3090	<0.0005	<0.0003	5.7872	0.0138	0.0167	0.0279	0.0074	0.0065

	Nb	Ti	V	W	Pb	Mg	Ca	Sb	Ta	B	N
	%	%	%	%	%	%	%	%	%	%	%
$\bar{x}$	0.0290	0.0010	0.0763	<0.0100	0.0016	0.0061	0.0013	<0.0010	<0.0050	<0.0005	0.0105

	Fe
	%
$\bar{x}$	92.31

LAMPIRAN 3

ZAT CUCI ASAM (PICKLING)

Informative Table 1 Chemical method for removal of corrosion products

Material	Chemicals	Time	Temperature	Remarks
Aluminium and aluminium alloy	Add 50 ml of phosphoric acid (**JIS K 9005**) and 20 g of chromium oxide (VI) (CrO_3) into distilled water to make up to 1 000 ml.	5 min to 10 min	90 °C boiling	When the coating of corrosive product remains, the following nitric acid treatment is successively carried out.
	Nitric acid (**JIS K 8541**)	1 min to 5 min	20 °C to 25 °C	In order to prevent a reaction inducing excessive removal of underlying metal, peripheral extraneous matter and bulky corrosion products are removed.
Anodic oxide film of aluminium	Add 10 ml of hydrochloric acid (**JIS K 8180**) into distilled water to make up to 110 ml.	1 min to 5 min	20 °C to 25 °C	The film is washed with using of nylon-brush etc. immersed in solution, washed with water and then dried by ventilation. When the corrosion products remain, this operation is repeated.
Copper and copper alloy	Add 500 ml of hydrochloric acid (**JIS K 8180**) into distilled water to make up to 1 000 ml.	1 min to 3 min	20 °C to 25 °C	Removal of air in solution with highly pure nitrogen controls the removal of underlying metal.
	Add 4.9 g of sodium cyanide (**JIS K 8447**) into distilled water to make up to 1 000 ml.	1 min to 3 min	20 °C to 25 °C	Corrosion product which is not likely to be removed by hydrochloric acid treatment mentioned above is removed. For example, copper sulphide.
	Add 100 ml of sulfuric acid (**JIS K 8951**) into distilled water to make up to 1 000 ml.	1 min to 3 min	20 °C to 25 °C	Bulky corrosion product is removed, prior to treatment, to prevent copper from adhering again to the surface of specimen.
	Add 120 ml of sulfuric acid (**JIS K 8951**) and 30 g of sodium bichromate bihydrate (**JIS K 8518**) into distilled water to make up to 1 000 ml.	5 s to 10 s	20 °C to 25 °C	Re-adhesion of copper resulting from the above-mentioned sulfuric acid treatment is removed.
Copper and copper alloy	Add 54 ml of sulfuric acid (**JIS K 8951**) into distilled water to make up to 1 000 ml.	30 min to 60 min	40 °C to 50 °C	Oxygen is separated from solution using nitrogen. To remove corrosion products, preferably brush the specimen and dip again for 3 s to 4 s.
Iron and steel	1 000 ml of hydrochloric acid (**JIS K 8180**), 20 g of antimony trioxide (III) (**JIS K 8407**) and 60 g of tin (II) chloride dihydrate (**JIS K 8136**)	1 min to 25 min	20 °C to 25 °C	Solution is sufficiently stirred, or otherwise specimen is brushed. When occasion demands, the process may be carried out for a longer time.
	Add 50 g of sodium hydroxide (**JIS K 8576**) and 200 g of thin strip of granular zinc (**JIS K 8012**) into distilled water to make up to 1 000 ml.	30 min to 40 min	80 °C to 90 °C	Since zinc powder may naturally ignite by contact with air, care shall be taken at using zinc powder.
	Add 50 g of sodium hydroxide (**JIS K 8576**) and 20 g of chip of granular zinc (**JIS K 8012**) into distilled water to make up to 1 000 ml.	30 min to 40 min	80 °C to 90 °C	Since zinc powder may naturally ignite by contact with air, care shall be taken at using zinc powder.
	Add 200 g of diammonium hydrogen citrate (**JIS K 8284**) into distilled water to make up to 1 000 ml.	20 min	75 °C to 90 °C	—
	Add 500 ml of hydrochloric acid (**JIS K 8180**) and 3.5 g of hexamethylenetetramine (**JIS K 8847**) into distilled water to make up to 1 000 ml.	10 min	20 °C to 25 °C	When occasion demands, the process may be carried out for a longer time.
Lead and lead alloy	Add 10 ml of acetic acid (**JIS K 8355**) into distilled water to make up to 1 000 ml.	5 min	Boiling	—
	Add 50 g of ammonium acetate (**JIS K 8359**) into distilled water to make up to 1 000 ml.	10 min	60 °C to 70 °C	—

LAMPIRAN 4

TABEL KONVERSI DIAMETER BUTIR (ASTM E 112)

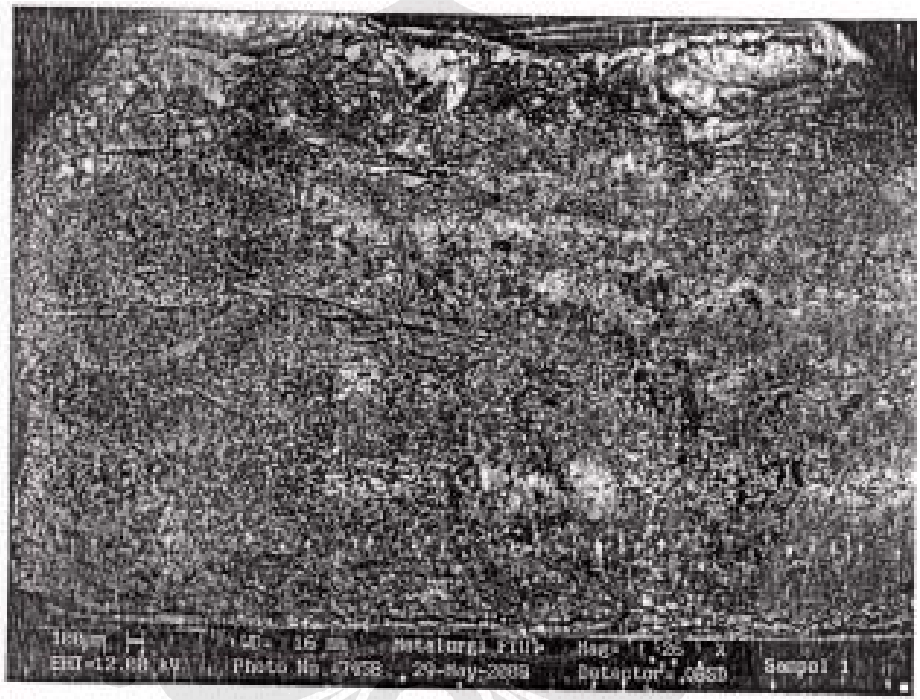
E 112 – 96$^{\epsilon 2}$

TABLE 4 Grain Size Relationships Computed for Uniform, Randomly Oriented, Equiaxed Grains

Grain Size No. G	$\bar{N}_A$ Grains/Unit Area		$\bar{A}$ Average Grain Area		$\bar{d}$ Average Diameter		$\bar{\ell}$ Mean Intercept		$\bar{N}_L$
	No./in.^{2} at 100X	No./mm^2 at 1X	mm^2	μm^2	mm	μm	mm	μm	No./mm
00	0.25	3.88	0.2581	258064	0.5080	508.0	0.4525	452.5	2.21
0	0.50	7.75	0.1290	129032	0.3592	359.2	0.3200	320.0	3.12
0.5	0.71	10.96	0.0912	91239	0.3021	302.1	0.2691	269.1	3.72
1.0	1.00	15.50	0.0645	64516	0.2540	254.0	0.2263	226.3	4.42
1.5	1.41	21.92	0.0456	45620	0.2136	213.6	0.1903	190.3	5.26
2.0	2.00	31.00	0.0323	32258	0.1796	179.6	0.1600	160.0	6.25
2.5	2.83	43.84	0.0228	22810	0.1510	151.0	0.1345	134.5	7.43
3.0	4.00	62.00	0.0161	16129	0.1270	127.0	0.1131	113.1	8.84
3.5	5.66	87.68	0.0114	11405	0.1068	106.8	0.0951	95.1	10.51
4.0	8.00	124.00	0.00806	8065	0.0898	89.8	0.0800	80.0	12.50
4.5	11.31	175.36	0.00570	5703	0.0755	75.5	0.0673	67.3	14.87
5.0	16.00	248.00	0.00403	4032	0.0635	63.5	0.0566	56.6	17.68
5.5	22.63	350.73	0.00285	2851	0.0534	53.4	0.0476	47.6	21.02
6.0	32.00	496.00	0.00202	2016	0.0449	44.9	0.0400	40.0	25.00
6.5	45.25	701.45	0.00143	1426	0.0378	37.8	0.0336	33.6	29.73
7.0	64.00	992.00	0.00101	1008	0.0318	31.8	0.0283	28.3	35.36
7.5	90.51	1402.9	0.00071	713	0.0267	26.7	0.0238	23.8	42.04
8.0	128.00	1984.0	0.00050	504	0.0225	22.5	0.0200	20.0	50.00
8.5	181.02	2805.8	0.00036	356	0.0189	18.9	0.0168	16.8	59.46
9.0	256.00	3968.0	0.00025	252	0.0159	15.9	0.0141	14.1	70.71
9.5	362.04	5611.6	0.00018	178	0.0133	13.3	0.0119	11.9	84.09
10.0	512.00	7936.0	0.00013	126	0.0112	11.2	0.0100	10.0	100.0
10.5	724.08	11223.2	0.000089	89.1	0.0094	9.4	0.0084	8.4	118.9
11.0	1024.00	15872.0	0.000063	63.0	0.0079	7.9	0.0071	7.1	141.4
11.5	1448.15	22446.4	0.000045	44.6	0.0067	6.7	0.0060	5.9	168.2
12.0	2048.00	31744.1	0.000032	31.5	0.0056	5.6	0.0050	5.0	200.0
12.5	2896.31	44892.9	0.000022	22.3	0.0047	4.7	0.0042	4.2	237.8
13.0	4096.00	63488.1	0.000016	15.8	0.0040	4.0	0.0035	3.5	282.8
13.5	5792.62	89785.8	0.000011	11.1	0.0033	3.3	0.0030	3.0	336.4
14.0	8192.00	126976.3	0.000008	7.9	0.0028	2.8	0.0025	2.5	400.0

LAMPIRAN 5

HASIL EDAX DARI SCALE HSLA 0.029% Nb



SEMQuant results. Listed at 15:06:42 on 29/05/08
Operator: jaya
Client: Dept. Metalurgi dan Material Universitas Indonesia
Job: Energy Dispersive X-Ray Analysis
Spectrum label: Sampel 1 - 01

System resolution = 60 eV

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

1 peak possibly omitted: -0.02 keV

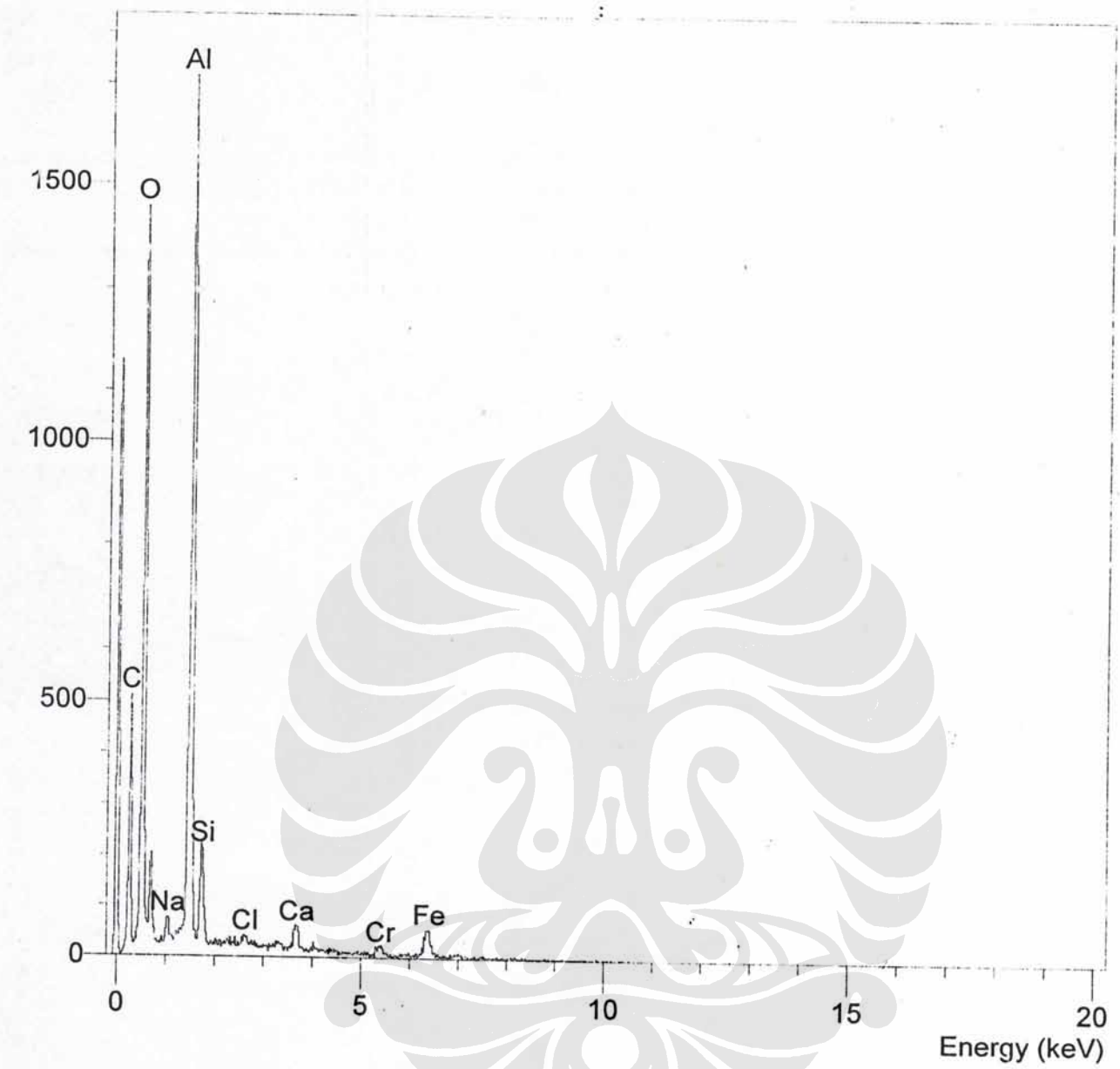
Standards :

C	K	Carbon Low 13/09/06
O	K	AL2O3 22/03/06
Na	K	Orthoclase 22/03/06
Al	K	CeAl2 03/03/07
Si	K	Low Carbon Steel 13/09/06
Cl	K	KCl 15/02/94
Ca	K	Orthoclase 22/03/06
Cr	K	Chromium 22/03/06
Fe	K	FeS2 22/03/06

Elmt	Spect. Type	Element %	Atomic %
C K	ED	4.30	7.92
O K	ED	38.23	52.87
Na K	ED	1.98	1.90
Al K	ED	30.77	25.24
Si K	ED	3.01	2.38
Cl K	ED	1.93	1.21
Ca K	ED	3.67	2.02
Cr K	ED	2.55	1.08
Fe K	ED	13.55	5.37
Total		100.00	100.00

* = <2 Sigma

Operator : jaya
Client : Dept. Metalurgi dan Material Universitas Indonesia
Job : Energy Dispersive X-Ray Analysis
Sampel 1 - 01 (29/05/08 15:00)



SEMQuant results. Listed at 15:15:09 on 29/05/08
Operator: jaya
Client: Dept. Metalurgi dan Material Universitas Indonesia
Job: Energy Dispersive X-Ray Analysis
Spectrum label: Sampel 1 - 02

System resolution = 60 eV

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

1 peak possibly omitted: -0.02 keV

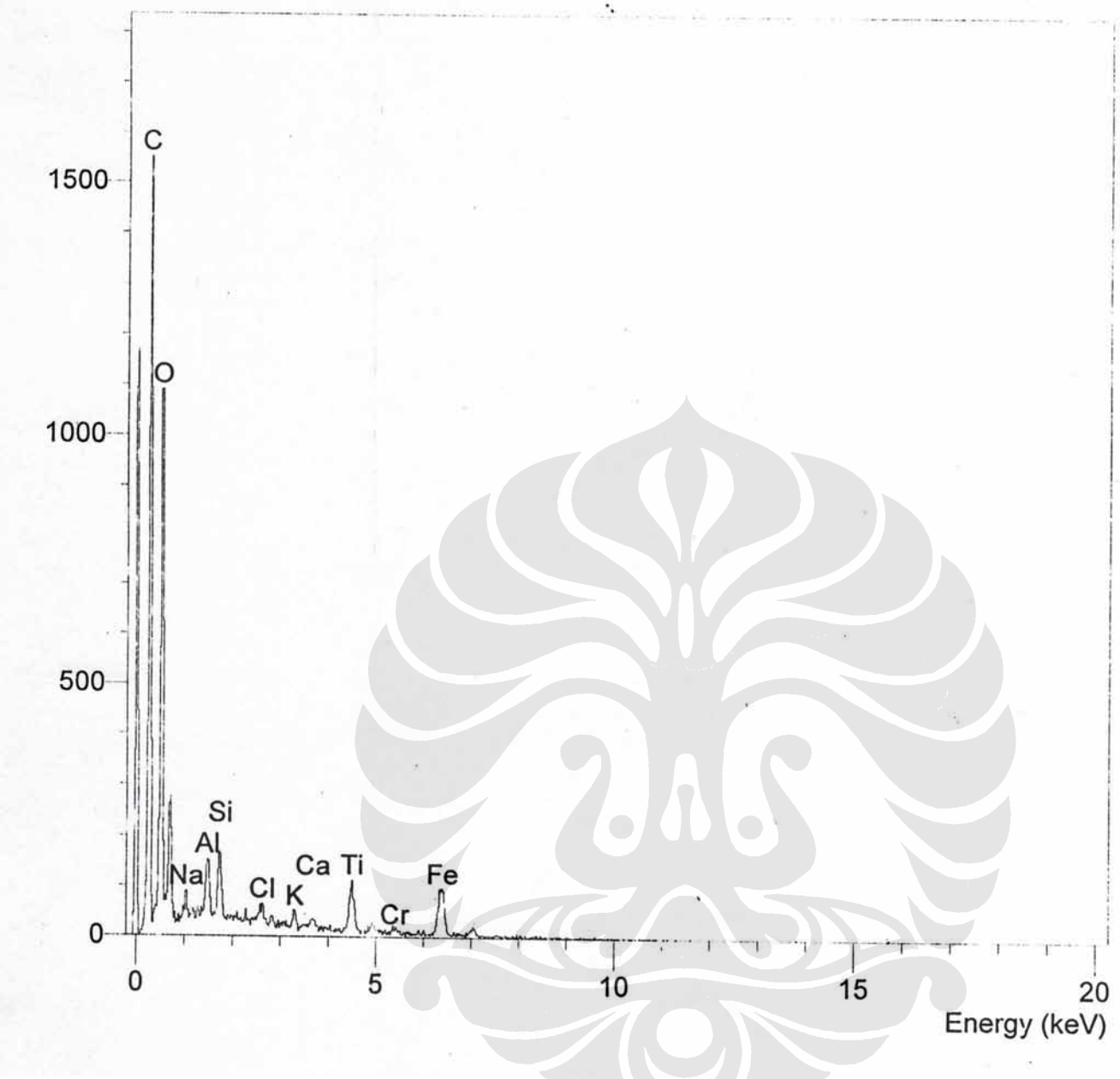
Standards :

C K	Carbon Low 13/09/06
O K	AL2O3 22/03/06
Na K	Orthoclase 22/03/06
Al K	CeAl2 03/03/07
Si K	Low Carbon Steel 13/09/06
Cl K	KCl 15/02/94
K K	Orthoclase 22/03/06
Ca K	Orthoclase 22/03/06
Ti K	Titanium Oxide 19/05/06
Cr K	Chromium 22/03/06
Fe K	FeS2 22/03/06

Elmt	Spect. Type	Element %	Atomic %
C K	ED	7.50	14.78
O K	ED	38.21	56.52
Na K	ED	2.45	2.52
Al K	ED	2.73	2.39
Si K	ED	1.76	1.48
Cl K	ED	3.54	2.37
K K	ED	2.00	1.21
Ca K	ED	1.22	0.72
Ti K	ED	10.70	5.29
Cr K	ED	1.73	0.79
Fe K	ED	28.16	11.93
Total		100.00	100.00

* = <2 Sigma

Operator : jaya
Client : Dept. Metalurgi dan Material Universitas Indonesia
Job : Energy Dispersive X-Ray Analysis
Sampel 1 - 02 (29/05/08 15:12)



SEMQuant results. Listed at 15:22:41 on 29/05/08
Operator: jaya
Client: Dept. Metalurgi dan Material Universitas Indonesia
Job: Energy Dispersive X-Ray Analysis
Spectrum label: Sampel 1 - 03

System resolution = 60 eV

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

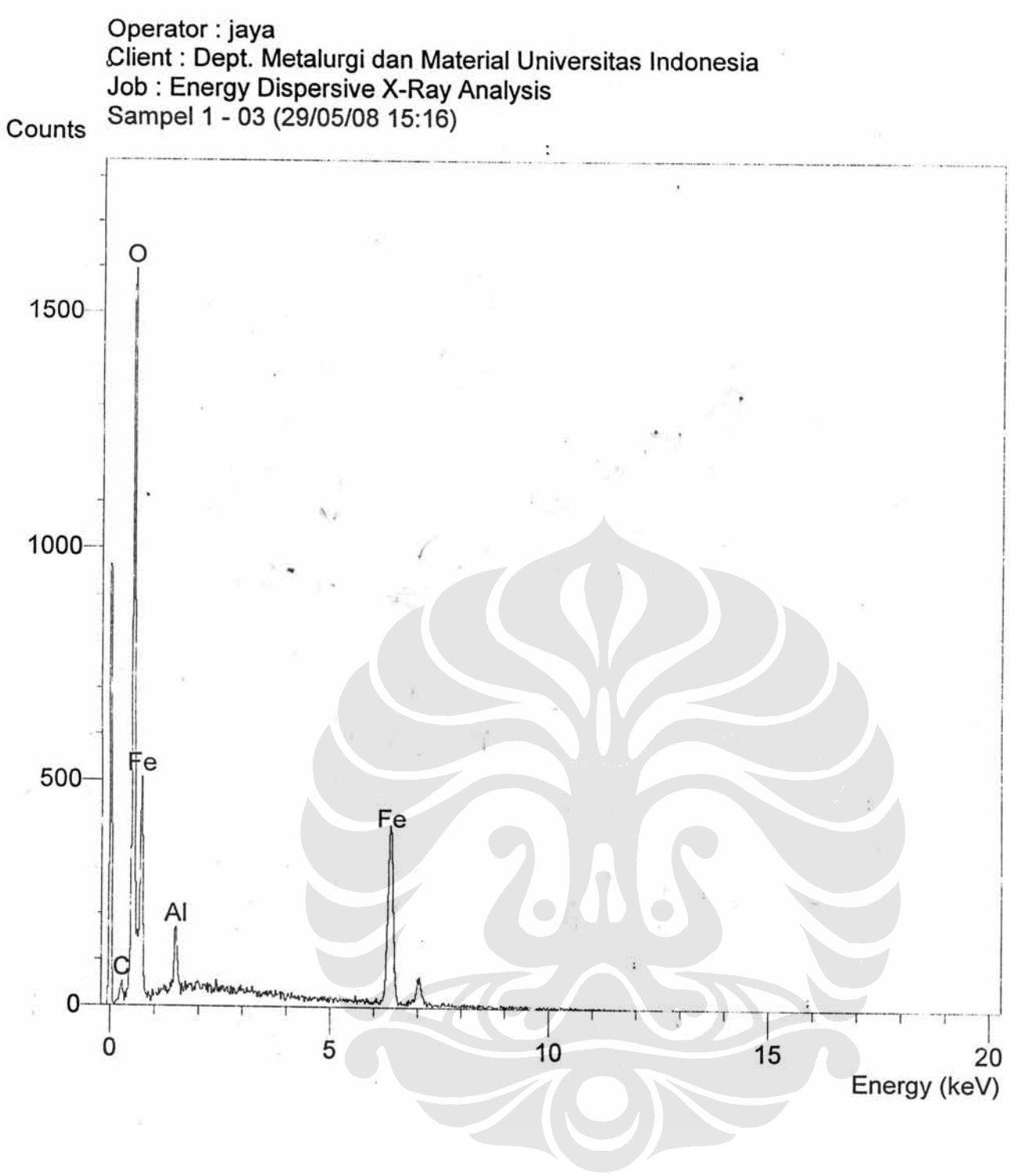
1 peak possibly omitted: -0.02 keV

Standards :

C	K	Carbon Low 13/09/06
O	K	AL2O3 22/03/06
Al	K	CeAl2 03/03/07
Fe	K	FeS2 22/03/06

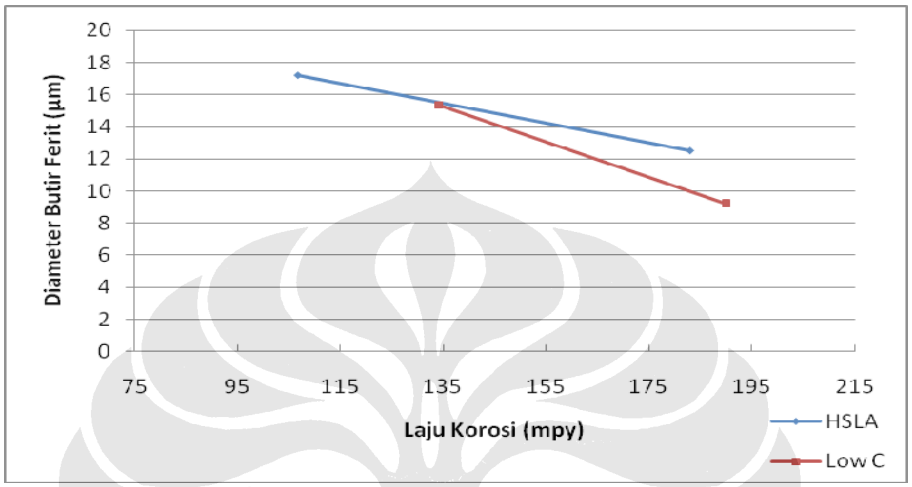
Elmt	Spect. Type	Element %	Atomic %
C K	ED	0.28	0.81
O K	ED	22.21	48.76
Al K	ED	2.49	3.24
Fe K	ED	75.03	47.19
Total		100.00	100.00

* = <2 Sigma


Operator : jaya
Client : Dept. Metalurgi dan Material Universitas Indonesia
Job : Energy Dispersive X-Ray Analysis
Sampel 1 - 03 (29/05/08 15:16)
Counts
1500
1000
500
0
O
Fe
C
Al
Fe
0
5
10
15
20
Energy (keV)

LAMPIRAN 6

PERHITUNGAN KEMIRINGAN GRAFIK LAJU KOROSI



Material	d Ferit (µm)	Laju Korosi (mpy)
Low C *bulk*	9.17 ± 0.12	190.51
Low C *air cooling*	15.37 ± 0.23 µm	134.12
HSLA *bulk*	12.53 ± 0.4	183.12
HSLA *air cooling*	17.2 ± 0.9	106.82

Perhitungan kemiringan garis menggunakan persamaan berikut, n = $\Delta y/\Delta x$

Untuk baja karbon rendah:

$$\left[\frac{9{,}17 - 15{,}37}{190{,}51 - 134{,}12}\right] = 0{,}1099$$

n= 0,1099 ≈ 0,11

Untuk baja HSLA:

$$\left[\frac{12{,}53 - 17{,}2}{183{,}12 - 106{,}82}\right] = 0{,}06$$

n = 0,06