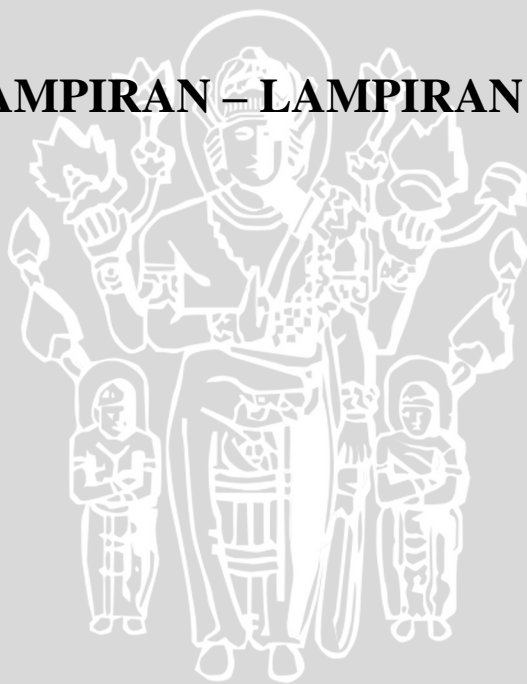


UNIVERSITAS BRAWIJAYA

**LAMPIRAN – LAMPIRAN**



Surat Keterangan Penelitian



KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN  
**POLITEKNIK NEGERI MALANG**  
**JURUSAN TEKNIK MESIN**  
Jl. Veteran PO. Box 04 Malang 65145 Telp/Fax. (0341)550180  
<http://www.poltek-malang.ac.id>



**SURAT KETERANGAN**  
**NOMOR : 027/PL2.TM/KM/2014**

Yang bertanda tangan dibawah ini :

Nama : Imam Mashudi B. Eng (HONS), M.T  
NIP : 19631110 199103 1 003  
Jabatan : Ketua Jurusan Teknik Mesin  
Politeknik Negeri Malang

Menerangkan dengan sesungguhnya bahwa mahasiswa :

Nama : Bagus Tri Subangga  
Nim : 0910620040  
Jurusan : Teknik Mesin  
Fakultas : Teknik  
Universitas Brawijaya Malang

Benar benar telah melaksanakan penelitian elektroplating dan pengujian ketebalan di Jurusan Teknik Mesin Politeknik Negeri Malang pada tanggal 20 Desember 2013 guna keperluan penyusunan skripsi.

Demikian surat keterangan ini dibuat untuk dipergunakan sebagaimana mestinya.

17 Januari 2014

Ketua Jurusan Teknik Mesin



Imam Mashudi B. Eng (HONS), M.T  
19631110 199103 1 003



Tabel Data hasil pengujian ketebalan dengan *Permascope MP0D*

Variasi		Pengulangan	ketebalan lapisan total			Rata-Rata ketebalan
anoda	waktu		titik 1	titik 2	titik 3	
Zinc	15	1	10.9	10.4	7.8	9.7
		2	10.8	10.2	6.8	9.2666667
		3	10.6	10.5	6.7	9.2666667
	30	1	17.4	15.1	12.8	15.1
		2	19.9	19	18.8	19.2333333
		3	18.1	17.5	11.4	15.6666667
	45	1	28.1	21.2	16.4	21.9
		2	26.8	20.1	16.7	21.2
		3	27.3	18.3	14.2	19.9333333
	60	1	30.3	21.9	17.8	23.3333333
		2	32.4	26.2	10.9	23.1666667
		3	59.6	29.3	12.3	33.7333333
Nikel	15	1	10.2	8.4	6.3	8.3
		2	11	6.9	6.9	8.2666667
		3	11.7	9.1	7.2	9.3333333
	30	1	15.3	16.1	19.4	16.9333333
		2	16.1	11.4	15.5	14.3333333
		3	14.7	19.2	12.6	15.5
	45	1	22.4	17.3	11.6	17.1
		2	19.6	21.2	18	19.6
		3	23.8	20	17.8	20.5333333
	60	1	27.5	24.6	20.7	24.2666667
		2	25.3	23.2	21.9	23.4666667
		3	26.7	22	22	23.5666667
Krom	15	1	9	8.2	6	7.7333333
		2	7.3	8	5	6.7666667
		3	7.8	6.1	6	6.6333333
	30	1	11.6	9.5	7.9	9.6666667
		2	13.4	8.8	7	9.7333333
		3	12.3	8.1	6.2	8.8666667
	45	1	19	14.2	13.6	15.6
		2	16.3	11.7	15	14.3333333
		3	17.8	19.1	12.4	16.4333333
	60	1	25.2	21.7	24.1	23.6666667
		2	19.7	23.3	18.2	20.4
		3	18.6	21	18.3	19.3

Ketebalan dalam mikron( $\mu\text{m}$ )



Pengujian komposisi *Grinding Ball* Semen Gresik

LONGWEAR LIMITED

TEST REPORT

CUSTOMER : PT Semen Indonesia (Persero) Tbk

DATE : 19<sup>th</sup> April 2013

TEST No. : CJH/TW/3410

CHEMICAL COMPOSITION & HARDNESS RESULTS

SIZE	C%	Si%	S%	P%	Mn%	Ni%	Cr%	Mo%	Fe%	HRc
90mm	2.305	0.520	0.053	0.070	0.232	0.166	15.970	0.020	80.403	61.2
50mm	2.490	0.436	0.064	0.088	0.343	0.173	11.943	0.017	84.185	66.5
40mm	2.448	0.359	0.100	0.115	0.441	0.202	11.517	0.018	84.482	63.5
30mm	3.280	0.354	0.071	0.076	0.475	0.188	12.811	0.020	82.466	65.5
25mm	3.060	0.671	0.052	0.037	0.300	0.124	11.358	0.013	83.988	66.8
20mm	3.156	0.785	0.050	0.030	0.370	0.122	12.156	0.013	82.839	64.5
17mm	2.723	0.840	0.069	0.045	0.332	0.195	11.016	0.020	84.242	66.5

AUTHORISED BY : 

DATE : 19/4/13

Harga potensial elektroda

Elektroda	Potensial (V)	Elektroda	Potensial (V)
Li $\rightleftharpoons$ Li $\pm$	- 3, 045	Co $\rightleftharpoons$ Co $^{2+}$	- 0,227
Rb $\rightleftharpoons$ Rb $\pm$	- 2, 93	Ni $\rightleftharpoons$ Ni $^{2+}$	- 0, 250
K $\rightleftharpoons$ K $^{+}$	- 2. 924	Sn $\rightleftharpoons$ Sn $^{2+}$	- 0, 136
Ba $\rightleftharpoons$ Ba $^{2+}$	- 2, 90	Pb $\rightleftharpoons$ Pb $^{2+}$	- 0, 126
Sr $\rightleftharpoons$ Sr $^{2+}$	- 2, 90	Fe $\rightleftharpoons$ Fe $^{3+}$	- 0, 04
Ca $\rightleftharpoons$ Ca $^{2+}$	- 2, 87	Pt/H $_{2}$ $\rightleftharpoons$ H $^{+}$	0 . 0000
Na $\rightleftharpoons$ Na $^{+}$	- 2, 715	Sb $\rightleftharpoons$ Sb $^{3+}$	+ 0, 15
Mg $\rightleftharpoons$ Mg $^{2+}$	- 2, 37	Bi $\rightleftharpoons$ Bi $^{3+}$	+ 0, 2
Al $\rightleftharpoons$ Al $^{3+}$	- 1, 67	As $\rightleftharpoons$ As $^{3+}$	+ 0,3
Mn $\rightleftharpoons$ Mn $^{2+}$	- 1, 18	Cu $\rightleftharpoons$ Cu $^{2+}$	+ 0, 34
Zn $\rightleftharpoons$ Zn $^{2+}$	- 0, 762	Pt/OH $\rightleftharpoons$ O $_{2}$	+ 0, 40
Cr $\rightleftharpoons$ Cr $^{3+}$	- 0, 74	Cu $\rightleftharpoons$ Cu $^{+}$	+ 0, 52
Cr $\rightleftharpoons$ Cr $^{2+}$	- 0, 56	Hg $\rightleftharpoons$ Hg $^{2+}$	+ 0, 789
Fe $\rightleftharpoons$ Fe $^{2+}$	- 0, 441	Ag $\rightleftharpoons$ Ag $^{+}$	+ 0, 799
Cd $\rightleftharpoons$ Cd $^{2+}$	- 0, 402	Pd $\rightleftharpoons$ Pd $^{2+}$	+ 0, 987
In $\rightleftharpoons$ In $^{3+}$	- 0, 34	Au $\rightleftharpoons$ Au $^{+}$	+ 1,50
Tl $\rightleftharpoons$ Tl $^{+}$	- 0,336	An $\rightleftharpoons$ An $^{+}$	+ 1,68

Sumber : *Mengenal Pelapisan Logam (Elektroplating)*, Hartomo, J. Anton.

## Properti bahan

Bahan	Berat jenis ( $\text{Mg/m}^3$ ) ( $= \text{g/cm}^3$ )	Daya hantar panas ( $\frac{\text{watt}}{\text{mm}^2}$ ) / ( $\frac{^\circ\text{C}}{\text{mm}}$ )**	Muai linier, $^\circ\text{C}^{-1}$ †	Tahanan listrik, $\rho$ ohm $\text{m}^2$	Modulus elastisitas rata2 $\bar{E}$	
					MPa	psi
<b>Logam</b>						
Aluminium (99,9+)	2.7	0.22	$22.5 \times 10^{-6}$	$29 \times 10^{-9}$	70,000	$10 \times 10^6$
Paduan aluminium	2.7(+)	0.16	$22 \times 10^{-6}$	$\sim 45 \times 10^{-9}$	70,000	$10 \times 10^6$
Kuningan (70 Cu–30 Zn)	8.5	0.12	$20 \times 10^{-6}$	$62 \times 10^{-9}$	110,000	$16 \times 10^6$
Perunggu (95 Cu–5 Sn)	8.8	0.08	$18 \times 10^{-6}$	$\sim 100 \times 10^{-9}$	110,000	$16 \times 10^6$
Besi Car (kelabu)	7.15	—	$10 \times 10^{-6}$	—	140,000(±)	$20 \times 10^6 \pm$
Besi Car (putih)	7.7	—	$9 \times 10^{-6}$	$660 \times 10^{-9}$	205,000	$30 \times 10^6$
Tembaga (99,9+)	8.9	0.40	$17 \times 10^{-6}$	$17 \times 10^{-9}$	110,000	$16 \times 10^6$
Besi (99,9+)	7.88	0.072	$11.7 \times 10^{-6}$	$98 \times 10^{-9}$	205,000	$30 \times 10^6$
Timbel (99+)	11.34	0.033	$29 \times 10^{-6}$	$206 \times 10^{-9}$	14,000	$2 \times 10^6$
Magnesium (99+)	1.74	0.16	$25 \times 10^{-6}$	$45 \times 10^{-9}$	45,000	$6.5 \times 10^6$
Monel (70 Ni–30 Cu)	8.8	0.025	$15 \times 10^{-6}$	$482 \times 10^{-9}$	180,000	$26 \times 10^6$
Perak (Sterling)	10.4	0.41	$18 \times 10^{-6}$	$18 \times 10^{-9}$	75,000	$11 \times 10^6$
Baja (1020)	7.86	0.050	$11.7 \times 10^{-6}$	$169 \times 10^{-9}$	205,000	$30 \times 10^6$
Baja (1040)	7.85	0.048	$11.3 \times 10^{-6}$	$171 \times 10^{-9}$	205,000	$30 \times 10^6$
Baja (1080)	7.84	0.046	$10.8 \times 10^{-6}$	$180 \times 10^{-9}$	205,000	$30 \times 10^6$
Baja (18 Cr – 8 Ni tahan karat)	7.93	0.015	$16 \times 10^{-6}$	$700 \times 10^{-9}$	205,000	$30 \times 10^6$
<b>Keramik.</b>						
$\text{Al}_2\text{O}_3$	3.8	0.029	$9 \times 10^{-6}$	$> 10^{12}$	350,000	$50 \times 10^6$
<b>Bata</b>						
Bangunan	2.3(±)	0.0006	$9 \times 10^{-6}$	—	—	—
Tahan api	2.1	0.0008	$4.5 \times 10^{-6}$	$1.4 \times 10^6$	—	—
Grafit	1.5	—	$5 \times 10^{-6}$	—	—	—
Gelas	—	—	$9 \times 10^{-6}$	—	14,000	$2 \times 10^6$
Lembaran	2.5	0.00075	$9 \times 10^{-6}$	$10^{12}$	70,000	$10 \times 10^6$
Borosilikat	2.4	0.0010	$2.7 \times 10^{-6}$	$> 10^{15}$	70,000	$10 \times 10^6$
Silika	2.2	0.0012	$0.5 \times 10^{-6}$	$10^{18}$	70,000	$10 \times 10^6$
Vycor	2.2	0.0012	$0.6 \times 10^{-6}$	—	—	—
Serat	0.05	0.00025	—	—	—	—
Grafit (curah)	1.9	—	$5 \times 10^{-6}$	$10^{-5}$	7,000	$1 \times 10^6$
MgO	3.6	—	$9 \times 10^{-6}$	$10^3$ (1100°C)	205,000	$30 \times 10^6$
Kwarsa ( $\text{SiO}_2$ )	2.65	0.012	—	$10^{12}$	310,000	$45 \times 10^6$
SiC	3.17	0.012	$4.5 \times 10^{-6}$	$0.025$ (1100°C)	—	—
TiC	4.5	0.030	$7 \times 10^{-6}$	$50 \times 10^{-8}$	350,000	$50 \times 10^6$
<b>Polimer</b>						
Melamin-formaldehida	1.5	0.00030	$27 \times 10^{-6}$	$10^{11}$	9,000	$1.3 \times 10^6$
Fenol-formaldehida	1.3	0.00016	$72 \times 10^{-6}$	$10^{10}$	3,500	$0.5 \times 10^6$
Urea formaldehida	1.5	0.00030	$27 \times 10^{-6}$	$10^{10}$	10,300	$1.5 \times 10^6$
Karet (Sintetik)	1.5	0.00012	—	—	4–75	600–11,000
Karet (vulkanisir)	1.2	0.00012	$81 \times 10^{-6}$	$10^{12}$	3,500	$0.5 \times 10^6$
Polietilen (L.D)	0.92	0.00034	$180 \times 10^{-6}$	$10^{13}$ – $10^{16}$	100–350	14,000–50,000
Polietilen (H.D.)	0.96	0.00052	$120 \times 10^{-6}$	$10^{12}$ – $10^{16}$	350–1,250	50,000–180,000
Polistiren	1.05	0.00008	$63 \times 10^{-6}$	$10^{16}$	2,800	$0.4 \times 10^6$
Poliviniliden khlorida	1.7	0.00012	$190 \times 10^{-6}$	$10^{11}$	350	$0.05 \times 10^6$
politetraouretilen	2.2	0.00020	$100 \times 10^{-6}$	$10^{14}$	350–700	50,000–100,000
polimetil metakrilat	1.2	0.00020	$90 \times 10^{-6}$	$10^{14}$	3,500	$0.5 \times 10^6$
Nilon	1.15	0.00025	$100 \times 10^{-6}$	$10^{12}$	2,000	$0.4 \times 10^6$

Sumber : ilmu dan teknologi bahan, Van Vlack

**Dokumentasi Penelitian**

Hasil elektroplating khrom selama 15 menit



Hasil elektroplating khrom selama 30 menit



Hasil elektroplating khrom selama 45 menit



Hasil elektroplating khrom selama 60 menit



Hasil elektroplating seng selama 15 menit



Hasil elektroplating seng selama 30 menit



Hasil elektroplating seng selama 45 menit



Hasil elektroplating seng selama 60 menit





Hasil elektroplating nikel selama 15 menit



Hasil elektroplating nikel selama 30 menit



Hasil elektroplating nikel selama 45 menit



Hasil elektroplating nikel selama 60 menit

