LAMPIRAN 1 Tabel Pengamatan Selama Proses *Anodiz* pada konsentrasi asam sulfat 30%

Waktu (m)	Voltase (V)	Ampere (A)	Suhu (^{O}C)
0	18.0	3.00	27.0
1	13.0	3.01	27.0
2	13.7	3.01	27.0
3	13.7	3.01	28.0
4	13.5	3.01	28.0
5	13.3	3.01	29.0
6	13.3	3.01	29.0
7	13.4	3.01	30.0
8	13.5	3.01	31.0
9	13.4	3.01	31.0
10	13.3	3.01	32.0

Benda 1
Variasi 30% H2SO4 + 70% air RO

Waktu (m)	Voltase (V)	Ampere (A)	Suhu (^{O}C)
0	18.0	3.00	31.0
1	12.1	2.99	32.0
2	12.4	3.00	32.0
3	12.1	3.00	33.0
4	12.3	3.00	33.0
5	12.7	3.00	34.0
6	12.9	3.00	34.0
7	12.9	3.00	35.0
8	12.9	3.00	35.0
9	13.0	3.00	36.0
10	13.0	3.00	36.0

Benda 2
Variasi 30% H2SO4 + 70% air RO

Waktu (m)	Voltase (V)	Ampere (A)	Suhu (^{O}C)
0	18.0	3.00	28.0
1	12.5	2.99	28.0
2	12.8	3.00	28.5
3	13.1	3.00	29.0
4	13.6	3.00	29.5
5	14.2	3.00	30.0
6	13.9	3.00	31.0
7	13.7	3.00	31.0
8	13.9	3.00	32.0
9	14.0	3.00	33.0
10	13.7	3.00	33.5

Benda 3
Variasi 30% H2SO4 + 70% air RO

Waktu (m)	Voltase (V)	Ampere (A)	Suhu (^{O}C)
0	18.0	3.00	28.0
1	13.8	3.01	28.0
2	14.4	3.00	28.5
3	14.1	3.00	29.0
4	14.5	3.01	30.0
5	14.6	3.01	30.5
6	14.5	3.01	31.0
7	14.6	3.01	32.0
8	14.8	3.01	32.5
9	14.9	3.00	33.5
10	14.8	3.01	34.0

Benda 4
Variasi 30% H2SO4 + 70% air RO

Tabel Pengamatan Selama Proses *Anodiz* pada konsentrasi asam sulfat 40%

Waktu (m)	Voltase (V)	Ampere (A)	Suhu (^{O}C)
0	18.0	3.00	30.0
1	15.2	2.98	30.5
2	15.3	2.98	31.0
3	15.9	2.98	31.5
4	17.0	2.98	32.0
5	17.4	2.98	33.0
6	17.9	2.98	34.0
7	18.0	2.96	35.0
8	17.5	2.98	35.5
9	17.3	2.99	36.0
10	17.0	2.99	37.0

Benda 1
Variasi 40% H2SO4 + 60% air RO

Waktu (m)	Voltase (V)	Ampere (A)	Suhu (^{O}C)
0	18.0	3.00	35.0
1	12.1	2.99	35.0
2	12.9	2.99	35.0
3	14.3	2.99	36.0
4	15.6	2.98	36.5
5	16.8	2.98	37.0
6	17.2	2.98	38.0
7	17.2	2.98	39.0
8	17.1	2.98	39.5
9	17.3	2.98	40.0
10	16.9	2.99	41.0

Benda 2
Variasi 40% H2SO4 + 60% air RO

Waktu (m)	Voltase (V)	Ampere (A)	Suhu (^{O}C)
0	18.0	3.00	35.5
1	12.9	3.00	36.0
2	13.7	2.99	36.0
3	15.0	2.99	36.5
4	15.8	2.98	37.0
5	16.2	2.98	37.5
6	12.9	2.99	38.0
7	17.5	2.98	39.0
8	14.6	2.99	39.5
9	15.7	2.98	40.0
10	14.8	2.99	41.0

Benda 3
Variasi 40% H2SO4 + 60% air RO

Waktu (m)	Voltase (V)	Ampere (A)	Suhu (^{O}C)
0	18.0	3.00	39.0
1	10.6	2.99	39.0
2	11.2	2.99	39.0
3	12.5	2.99	40.0
4	13.5	2.99	40.0
5	14.4	2.99	40.0
6	14.7	2.99	40.5
7	15.2	2.98	41.0
8	14.9	2.99	42.0
9	14.9	2.99	42.5
10	14.9	2.99	42.5

Benda 4
Variasi 40% H2SO4 + 60% air RO

Tabel Pengamatan Selama Proses *Anodiz* pada konsentrasi asam sulfat 50%

Waktu (m)	Voltase (V)	Ampere (A)	Suhu (^{O}C)
0	18.0	3.00	30.0
1	18.0	2.65	31.0
2	18.0	2.61	31.5
3	18.0	2.80	32.0
4	18.0	1.77	32.0
5	18.0	1.61	32.5
6	18.0	1.48	33.0
7	18.0	1.36	33.5
8	18.0	1.26	34.0
9	18.0	1.18	34.5
10	18.0	1.13	35.0

Benda 1
Variasi 50% H2SO4 + 50% air RO

Waktu (m)	Voltase (V)	Ampere (A)	Suhu (^{O}C)
0	18 .0	3.00	36.0
1	16.5	2.99	36.5
2	18.0	2.88	36.5
3	18.0	2.55	37.0
4	18.0	2.17	37.5
5	18.0	1.99	38.0
6	18.0	1.80	38.5
7	18.0	1.65	39.0
8	18.0	1.52	39.5
9	18.0	1.39	40.0
10	18.0	1.30	40.0

Benda 2
Variasi 50% H2SO4 + 50% air RO

Waktu (m)	Voltase (V)	Ampere (A)	Suhu (^{O}C)
0	18.0	3.00	28.0
1	16.4	2.98	28.5
2	18.8	2.88	29.0
3	18.8	2.60	30.0
4	18.8	2.30	30.3
5	18.8	2.02	31.0
6	18.8	1.90	31.5
7	18.8	1.78	32.0
8	18.0	1.61	32.5
9	18.0	1.51	33.0
10	18.0	1.42	33.5

Benda 3
Variasi 50% H2SO4 + 50% air RO

Waktu (m)	Voltase (V)	Ampere (A)	Suhu (^{O}C)
0	18.0	3.00	34.0
1	14.7	2.99	35.0
2	16.1	2.99	35.5
3	18.0	2.89	36.0
4	18.0	2,73	36.5
5	18.0	2.42	37.0
6	18.0	2.28	37.5
7	18.0	2.14	38.0
8	18.0	2.02	38.5
9	18.0	1.87	39.0
10	18.0	1.82	39.5

Benda 4
Variasi 50% H2SO4 + 50% air RO

LAMPIRAN 2 Contoh Perhitungan Nilai Kekerasan Rata-Rata (VHN) Ketebalan Lapisan Oksida

Contoh perhitungan nilai kekerasan rata-rata (VHN) ketebalan lapisan oksida pada *raw* material.

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x P}}{(\text{d}^2)}$$

Diketahui :

P = 25 (gf)

P = 25 gf . 10 x 10^{-3} kgf

P = 0,025 kgf

$\text{d}_{\text{rata-rata}} = \frac{35{,}5+35{,}75+35{,}5}{3}$ (μm) = 35,58 μm x 10^{-3} = 0,03558 mm

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x } 0{,}025}{(\text{d}^2)}$$

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x } 0{,}025}{(0{,}03558^2)}$$

$$\text{Kekerasan rata} - \text{rata} = 36{,}61 \text{ VHN}$$

Contoh perhitungan nilai kekerasan rata-rata (VHN) ketebalan lapisan oksida setelah proses *anodizing* dengan variasi konsentrasi asam sulfat 30% pada larutan anodiz.

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x P}}{(\text{d}^2)}$$

Diketahui :

P = 25 (gf)

P = 25 gf . 10 x 10^{-3} kgf

P = 0,025 kgf

$d_{rata\text{-}rata} = \frac{30{,}00+30{,}00+29{,}50}{3}$ (μm) = 29,83 μm x 10^{-3} = 0,02983 mm

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x } 0{,}025}{(d^2)}$$

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x } 0{,}025}{(0{,}02983^2)}$$

$$\text{Kekerasan rata} - \text{rata} = 52{,}088 \text{ VHN}$$

Contoh perhitungan nilai kekerasan rata-rata (VHN) ketebalan lapisan oksida setelah proses *anodizing* dan *dyeing* dengan variasi konsentrasi asam sulfat 30% pada larutan anodiz.

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x P}}{(d^2)}$$

Diketahui :

P = 25 (gf)

P = 25 gf . 10 x 10^{-3} kgf

P = 0,025 kgf

$d_{rata\text{-}rata} = \frac{29{,}50+30{,}00+30{,}50}{3}$ (μm) = 30,00 μm x 10^{-3} = 0,03000 mm

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x } 0{,}025}{(d^2)}$$

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x } 0{,}025}{(0{,}03000^2)}$$

$$\text{Kekerasan rata} - \text{rata} = 51{,}50 \text{ VHN}$$

Contoh perhitungan nilai kekerasan rata-rata (VHN) ketebalan lapisan oksida setelah proses *anodizing* dengan variasi konsentrasi asam sulfat 40% pada larutan anodiz.

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x P}}{(\text{d}^2)}$$

Diketahui :

P = 25 (gf)

P = 25 gf . 10 x 10^{-3} kgf

P = 0,025 kgf

$d_{\text{rata-rata}} = \frac{22{,}75+22{,}00+24{,}00}{3}$ (μm) = 22,92 μm x 10^{-3} = 0,02292 mm

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x } 0{,}025}{(\text{d}^2)}$$

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x } 0{,}025}{(0{,}02292^2)}$$

$$\text{Kekerasan rata} - \text{rata} = 88{,}26 \text{ VHN}$$

Contoh perhitungan nilai kekerasan rata-rata (VHN) ketebalan lapisan oksida setelah proses *anodizing* dan *dyeing* dengan variasi konsentrasi asam sulfat 40% pada larutan anodiz.

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x P}}{(\text{d}^2)}$$

Diketahui :

P = 25 (gf)

P = 25 gf . 10 x 10^{-3} kgf

P = 0,025 kgf

$d_{rata\text{-}rata} = \frac{27{,}00+28{,}50+27{,}25}{3}$ (μm) = 27,58 μm x 10^{-3} = 0,02758 mm

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x } 0{,}025}{(d^2)}$$

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x } 0{,}025}{(0{,}02758^2)}$$

$$\text{Kekerasan rata} - \text{rata} = 60{,}93 \text{ VHN}$$

Contoh perhitungan nilai kekerasan rata-rata (VHN) ketebalan lapisan oksida setelah proses *anodizing* dengan variasi konsentrasi asam sulfat 50% pada larutan anodiz.

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x P}}{(d^2)}$$

Diketahui :

P = 25 (gf)

P = 25 gf . 10 x 10^{-3} kgf

P = 0,025 kgf

$d_{rata\text{-}rata} = \frac{30{,}50+25{,}50+26{,}50}{3}$ (μm) = 27.50 μm x 10^{-3} = 0,02750 mm

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x } 0{,}025}{(d^2)}$$

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x } 0{,}025}{(0{,}02750^2)}$$

$$\text{Kekerasan rata} - \text{rata} = 61{,}28 \text{ VHN}$$

Contoh perhitungan nilai kekerasan rata-rata (VHN) ketebalan lapisan oksida setelah proses *anodizing* dan *dyeing* dengan variasi konsentrasi asam sulfat 50% pada larutan anodiz.

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x P}}{(\text{d}^2)}$$

Diketahui :

P = 25 (gf)

P = 25 gf . 10 x 10^{-3} kgf

P = 0,025 kgf

$\text{d}_{\text{rata-rata}} = \frac{31{,}00+29{,}00+29{,}00}{3}$ (μm) = 29,66 μm x 10^{-3} = 0,02966 mm

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x } 0{,}025}{(\text{d}^2)}$$

$$\text{Kekerasan rata} - \text{rata} = \frac{1{,}854 \text{ x } 0{,}025}{(0{,}02966^2)}$$

$$\text{Kekerasan rata} - \text{rata} = 52{,}68 \text{ VHN}$$

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DEPARTEMEN TEKNIK MESIN SEKOLAH VOKASI
UNIVERSITAS GADJAH MADA

HASIL PENGUJIAN KEKERASAN

No. 030 / P.Kkr / BT.DTM / 2016

Spesimen Aluminium (Anodizing)

No	Kode	Posisi titik uji		d_1 (μm)	d_2 (μm)	$d_{rata-rata}$ (μm)	Kekerasan (VHN)
1	3070.1	Anodizing dan Sealing	Acak	27.0	26.0	26.50	66.0
				30.0	29.0	29.50	53.3
				29.0	28.0	28.50	57.1
		Anodizing	Acak	29.0	28.0	28.50	57.1
				30.0	31.0	30.50	49.8
				30.0	31.0	30.50	49.8
2	3070.2	Anodizing dan Sealing	Acak	31.0	31.0	31.00	48.2
				28.0	31.0	29.50	53.3
				28.0	29.0	28.50	57.1
		Anodizing	Acak	30.0	30.0	30.00	51.5
				30.0	30.0	30.00	51.5
				27.0	32.0	29.50	53.3
3	3070.4	Anodizing dan Sealing	Acak	30.0	29.0	29.50	53.3
				29.0	31.0	30.00	51.5
				31.0	30.0	30.50	49.8
		Anodizing	Acak	30.0	30.0	30.00	51.5
				30.0	30.0	30.00	51.5
				29.0	30.0	29.50	53.3
4	4060.1	Anodizing dan Sealing	Acak	27.0	27.0	27.00	63.6
				27.0	27.0	27.00	63.6
				28.0	27.0	27.50	61.3
		Anodizing	Acak	23.0	22.0	22.50	91.6
				26.0	24.0	25.00	74.2
				25.0	23.0	24.00	80.5
5	4060.3	Anodizing dan Sealing	Acak	27.0	27.0	27.00	63.6
				27.0	30.0	28.50	57.1
				28.5	26.0	27.25	62.4
		Anodizing	Acak	23.0	22.5	22.75	89.6
				22.0	22.0	22.00	95.8
				24.0	24.0	24.00	80.5
6	4060.4	Anodizing dan Sealing	Acak	30.0	29.0	29.50	53.3
				27.0	29.0	28.00	59.1
				29.0	29.0	29.00	55.1
		Anodizing	Acak	24.0	24.0	24.00	80.5
				23.0	23.0	23.00	87.6
				22.0	23.0	22.50	91.6

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LABORATORIUM BAHAN TEKNIK
DEPARTEMEN TEKNIK MESIN SEKOLAH VOKASI
UNIVERSITAS GADJAH MADA

Spesimen Aluminium (Anodizing)

No	Kode	Posisi titik uji		d_1 (µm)	d_2 (µm)	$d_{rata-rata}$ (µm)	Kekerasan (VHN)
7	5050.1	Anodizing dan Sealing	Acak	31.5	31.0	31.25	47.5
				32.0	31.0	31.50	46.7
				29.0	31.5	30.25	50.7
		Anodizing	Acak	28.0	26.0	27.00	63.6
				26.0	30.0	28.00	59.1
				28.0	28.0	28.00	59.1
8	5050.2	Anodizing dan Sealing	Acak	29.0	29.0	29.00	55.1
				29.0	29.0	29.00	55.1
				30.0	32.0	31.00	48.2
		Anodizing	Acak	30.0	31.0	30.50	49.8
				26.0	25.0	25.50	71.3
				25.0	28.0	26.50	66.0
9	5050.3	Anodizing dan Sealing	Acak	31.0	31.0	31.00	48.2
				29.0	28.0	28.50	57.1
				31.0	31.0	31.00	48.2
		Anodizing	Acak	29.0	28.0	28.50	57.1
				28.0	29.0	28.50	57.1
				30.0	30.0	30.00	51.5

Keterangan :

1. Menggunakan metode uji Vikers dengan pembebanan 25 gf
2. Satuan pengukuran diagonal jejak indentor dalam mm
3. Pengujian dilakukan pada tanggal 24 Februari 2016

Yogyakarta, 24 Februari 2016
Staf Laboratorium Bahan Teknik

Pengujian & Analisa Material
Lab. Bahan Teknik Departemen Teknik Mesin Sekolah Vokasi UGM

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