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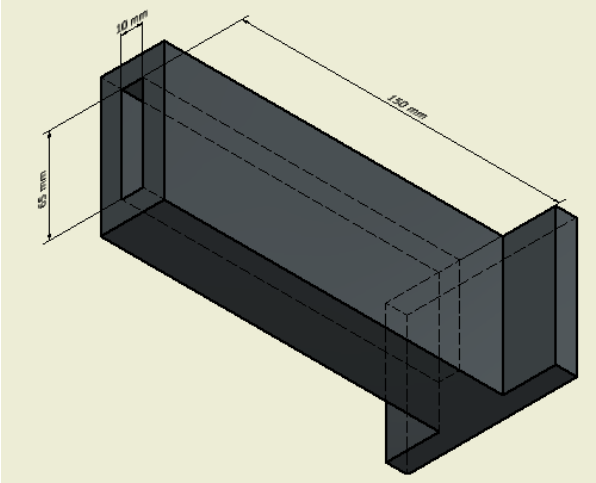
LAMPIRAN

Lampiran 1



Gambar desain cetakan pengecoran

Balok

Diketahui : Panjang = 15 cm Tinggi = 1 mm

Lebar = 6.5 cm

Density Aluminium = 2.71 g/cm^3

Ditanyakan : 1. Volume Balok

2. Berat Total

Penyelesaian :

Volume = Panjang x Lebar X Tinggi

= 15 x 6.5 x 1

= 104 cm^3

Berat Total = Volume Balok x Density Aluminium

= 104 cm^3 x 2.71 g/cm^3

= 281.84 g **(asumsi pembulatan 350 g)**

Jadi, dalam 1 cetakan kapasitas pengecoran sebanyak 350 g

Perencanaan formula persentase unsur yang ditambahkan pada proses

·an antara lain :

%, 6%, 8%

ł%, 6%, 8%

3. Zn 4%, 6%, 8%

Perhitungan persentase :

1. Cu
   4% dari kapasitas pengecoran 350 g = 4.76 g
   6% dari kapasitas pengecoran 350 g = 11.76 g
   8% dari kapasitas pengecoran 350 g = 18.76 g
   Note : untuk penambahan Cu ditambahkan dengan kandungan Cu pada komposisi material sebanyak 2.64% sehingga menghasilkan formula yang diinginkan. Example {(2.64% + 1.36% = 4%), (2.64% + 3.36% = 6%), (2.64% + 5.36% = 8%)}

2. Mg
   4% dari kapasitas pengecoran 350 g = 14 g + 5% = 14.7 g
   6% dari kapasitas pengecoran 350 g = 21 g + 5% = 22.05 g
   8% dari kapasitas pengecoran 350 g = 28 g + 5% = 29.4 g
   Note : untuk penambahan Mg ditambahkan 5% untuk meminimalisir penguapan sehingga menghasilkan formula yang diinginkan.

3. Zn
   4% dari kapasitas pengecoran 350 g = 9.555 g
   6% dari kapasitas pengecoran 350 g =16.555 g
   8% dari kapasitas pengecoran 350 g = 23.555 g
   Note : untuk penambahan Zn ditambahkan dengan kandungan Zn pada komposisi material sebanyak 1.27% sehingga menghasilkan formula yang diinginkan. Example {(1.27% + 2.73% = 4%), (1.27% + 4.73% = 6%), (1.27% + 6.73% = 8%)}

Lampiran 2

Perubahan berat spesimen saat pengujian korosi (gram)

No	Name	Purity (%)	Sudut (^{0})	Volume Aliran (L/H)	Berat (g)		Weight Loss (g)
					Awal	Akhir	
1	A383 Cu	4	30	45	8.6747	7.4486	1.2261
2	A383 Cu	4	30	60	8.2825	6.9901	1.2924
3	A383 Cu	4	30	75	8.7780	7.2936	1.4844
4	A383 Cu	6	30	45	8.6026	7.5885	1.0141
5	A383 Cu	6	30	60	8.6103	7.4987	1.1116
6	A383 Cu	6	30	75	8.6988	7.2936	1.4052
7	A383 Cu	8	30	45	8.6368	7.6520	0.9848
8	A383 Cu	8	30	60	8.6804	7.5951	1.0853
9	A383 Cu	8	30	75	8.8766	7.6413	1.2353
10	A383 Cu	4	40	45	8.6297	7.5384	1.0913
11	A383 Cu	4	40	60	8.7918	7.5343	1.2575
12	A383 Cu	4	40	75	8.7759	7.4473	1.3286
13	A383 Cu	6	40	45	8.8730	7.8686	1.0044
14	A383 Cu	6	40	60	8.5286	7.4233	1.1053
15	A383 Cu	6	40	75	8.678	7.4473	1.2307
16	A383 Cu	8	40	45	8.5509	7.5747	0.9762
17	A383 Cu	8	40	60	8.7496	7.7238	1.0258
18	A383 Cu	8	40	75	8.2093	7.0402	1.1691
19	A383 Cu	4	50	45	8.1767	7.2675	0.9092
20	A383 Cu	4	50	60	8.4520	7.3223	1.1297
21	A383 Cu	4	50	75	8.6325	7.4013	1.2312
22	A383 Cu	6	50	45	8.5667	7.6840	0.8827
23	A383 Cu	6	50	60	8.7572	7.6860	1.0712
24	A383 Cu	6	50	75	8.4341	7.2162	1.2179
25	A383 Cu	8	50	45	8.5907	7.7352	0.8555
26	A383 Cu	8	50	60	8.4230	7.4060	1.017
27	A383 Cu	8	50	75	8.7834	7.6573	1.1261
28	A383 Mg	4	30	45	8.4394	7.8302	0.6092
29	A383 Mg	4	30	60	8.404	7.7258	0.6782
30	A383 Mg	4	30	75	8.2033	7.504	0.6993
31	A383 Mg	6	30	45	8.1699	7.5701	0.5998
32	A383 Mg	6	30	60	8.0735	7.4151	0.6584
33	A383 Mg	6	30	75	8.2996	7.6061	0.6935
34	A383 Mg	8	30	45	8.2072	7.6158	0.5914
	383 Mg	8	30	60	8.1987	7.5976	0.6011
	383 Mg	8	30	75	8.0438	7.4347	0.6091
	383 Mg	4	40	45	8.2272	7.6244	0.6028
	383 Mg	4	40	60	8.2205	7.5436	0.6769

39	A383 Mg	4	40	75	8.131	7.4444	0.6866
40	A383 Mg	6	40	45	8.1276	7.5337	0.5939
41	A383 Mg	6	40	60	8.1848	7.5634	0.6214
42	A383 Mg	6	40	75	8.0915	7.4091	0.6824
43	A383 Mg	8	40	45	8.146	7.6068	0.5392
44	A383 Mg	8	40	60	8.1918	7.6243	0.5675
45	A383 Mg	8	40	75	8.1142	7.5124	0.6018
46	A383 Mg	4	50	45	8.2734	7.6814	0.592
47	A383 Mg	4	50	60	8.6505	7.9833	0.6672
48	A383 Mg	4	50	75	8.1617	7.4761	0.6856
49	A383 Mg	6	50	45	8.634	8.0629	0.5711
50	A383 Mg	6	50	60	8.1425	7.5327	0.6098
51	A383 Mg	6	50	75	8.5084	7.8407	0.6677
52	A383 Mg	8	50	45	8.3538	7.822	0.5318
53	A383 Mg	8	50	60	8.1138	7.5606	0.5532
54	A383 Mg	8	50	75	8.1711	7.6165	0.5546
55	A383 Zn	4	30	45	8.1259	6.8362	1.2897
56	A383 Zn	4	30	60	8.1745	6.7651	1.4094
57	A383 Zn	4	30	75	7.8956	6.4364	1.4592
58	A383 Zn	6	30	45	8.1775	6.9075	1.2700
59	A383 Zn	6	30	60	8.3295	6.9688	1.3607
60	A383 Zn	6	30	75	8.1570	6.7336	1.4234
61	A383 Zn	8	30	45	8.2019	7.1300	1.0719
62	A383 Zn	8	30	60	8.0798	6.9128	1.167
63	A383 Zn	8	30	75	8.4617	7.1895	1.2722
64	A383 Zn	4	40	45	7.9585	6.8182	1.1403
65	A383 Zn	4	40	60	7.9379	6.7489	1.189
66	A383 Zn	4	40	75	8.1274	6.8203	1.3071
67	A383 Zn	6	40	45	8.3773	7.2777	1.0996
68	A383 Zn	6	40	60	7.9901	6.8463	1.1438
69	A383 Zn	6	40	75	8.4568	7.2247	1.2321
70	A383 Zn	8	40	45	8.0954	7.1113	0.9841
71	A383 Zn	8	40	60	8.2991	7.1927	1.1064
72	A383 Zn	8	40	75	8.0349	6.8246	1.2103
73	A383 Zn	4	50	45	8.0811	7.1900	0.8911
74	A383 Zn	4	50	60	8.1685	7.0826	1.0859
75	A383 Zn	4	50	75	8.0568	6.8666	1.1902
76	A383 Zn	6	50	45	7.9874	7.1185	0.8689
77	A383 Zn	6	50	60	8.2902	7.2417	1.0485
[illegible]	A383 Zn	6	50	75	8.1058	6.9759	1.1299
[illegible]	A383 Zn	8	50	45	8.0954	7.2580	0.8374
[illegible]	A383 Zn	8	50	60	8.0625	7.0403	1.0222
[illegible]	A383 Zn	8	50	75	8.0309	6.9466	1.0843

82	A383	0	30	45	7.6529	6.3226	1.3303
83	A383	0	30	60	8.1702	6.7186	1.4516
84	A383	0	30	75	8.0246	6.5398	1.4848
85	A383	0	40	45	6.869	5.6846	1.1844
86	A383	0	40	60	8.2443	7.0027	1.2416
87	A383	0	40	75	7.9624	6.6288	1.3336
88	A383	0	50	45	7.041	6.1255	0.9155
89	A383	0	50	60	7.697	6.5571	1.1399
90	A383	0	50	75	6.7124	5.4716	1.2408

Setelah uji simulasi korosi selama 4 jam per sampel, spesimen dibersihkan sesuai prosedur pada standar ASTM G-1. Analisa kehilangan berat dilakukan dengan menimbang spesimen sebelum dan sesudah ekspos. Metode untuk menentukan laju korosi berdasarkan kehilangan berat dengan menggunakan density aluminium 2.71 g/cm^3. Dari data tabel 4.1 kemudian diolah sesuai dengan rumus dibawah ini, kita ambil contoh untuk material A383 Cu4% dengan sudut 30^0 dan kecepatan 45 l/h :

Diketahui : W = 1.2261 g

A = 17 cm^2

T = 4 jam

D = 2.71 g/cm^3

Konstanta = $3.45\ X\ 10^3$

Ditanyakan : Cr ?

Penyelesaian :

$$Cr = \frac{3.45X10^3.W}{A.T.D} = \frac{3.45X10^3.1,2261}{17.4.2,71} = \frac{4230,045}{184.28}$$

Cr = 22.95 ipy

Data hasil pengujian ketahanan korosi (ipy)

No	Name	Purity (%)	Sudut (^{0})	Volume Aliran (L/H)	Konstanta	Density	Surface Area (Cm^2)	Ekposur Time (jam)	Corrosion Rate (ipy)
1	A383 Cu	4	30	45	3.45	2.71	17	4	22.95
2	A383 Cu	4	30	60	3.45	2.71	17	4	24.19
3	A383 Cu	4	30	75	3.45	2.71	17	4	27.79
4	A383 Cu	6	30	45	3.45	2.71	17	4	18.98
5	A383 Cu	6	30	60	3.45	2.71	17	4	20.81
6	A383 Cu	6	30	75	3.45	2.71	17	4	26.30
7	A383 Cu	8	30	45	3.45	2.71	17	4	18.43
8	A383 Cu	8	30	60	3.45	2.71	17	4	20.31
9	A383 Cu	8	30	75	3.45	2.71	17	4	23.12
10	A383 Cu	4	40	45	3.45	2.71	17	4	20.43
11	A383 Cu	4	40	60	3.45	2.71	17	4	23.54
12	A383 Cu	4	40	75	3.45	2.71	17	4	24.87
13	A383 Cu	6	40	45	3.45	2.71	17	4	18.80
14	A383 Cu	6	40	60	3.45	2.71	17	4	20.69
15	A383 Cu	6	40	75	3.45	2.71	17	4	23.04
16	A383 Cu	8	40	45	3.45	2.71	17	4	18.27
17	A383 Cu	8	40	60	3.45	2.71	17	4	19.20
18	A383 Cu	8	40	75	3.45	2.71	17	4	21.88
19	A383 Cu	4	50	45	3.45	2.71	17	4	17.02
20	A383 Cu	4	50	60	3.45	2.71	17	4	21.14
21	A383 Cu	4	50	75	3.45	2.71	17	4	23.04
22	A383 Cu	6	50	45	3.45	2.71	17	4	16.52
23	A383 Cu	6	50	60	3.45	2.71	17	4	20.05
24	A383 Cu	6	50	75	3.45	2.71	17	4	22.80
25	A383 Cu	8	50	45	3.45	2.71	17	4	16.01
26	A383 Cu	8	50	60	3.45	2.71	17	4	19.03
27	A383 Cu	8	50	75	3.45	2.71	17	4	21.08
28	A383 Mg	4	30	45	3.45	2.71	17	4	11.41
29	A383 Mg	4	30	60	3.45	2.71	17	4	12.70
30	A383 Mg	4	30	75	3.45	2.71	17	4	13.09
31	A383 Mg	6	30	45	3.45	2.71	17	4	11.23
32	A383 Mg	6	30	60	3.45	2.71	17	4	12.33
33	A383 Mg	6	30	75	3.45	2.71	17	4	12.98
34	A383 Mg	8	30	45	3.45	2.71	17	4	11.07
[illegible]	[illegible]	8	30	60	3.45	2.71	17	4	11.25
[illegible]	[illegible]	8	30	75	3.45	2.71	17	4	11.40
[illegible]	[illegible]	4	40	45	3.45	2.71	17	4	11.29
[illegible]	[illegible]	4	40	60	3.45	2.71	17	4	12.67
[illegible]	[illegible]	4	40	75	3.45	2.71	17	4	12.85

40	A383 Mg	6	40	45	3.45	2.71	17	4	11.12
41	A383 Mg	6	40	60	3.45	2.71	17	4	11.63
42	A383 Mg	6	40	75	3.45	2.71	17	4	12.78
43	A383 Mg	8	40	45	3.45	2.71	17	4	10.09
44	A383 Mg	8	40	60	3.45	2.71	17	4	10.62
45	A383 Mg	8	40	75	3.45	2.71	17	4	11.27
46	A383 Mg	4	50	45	3.45	2.71	17	4	11.08
47	A383 Mg	4	50	60	3.45	2.71	17	4	12.49
48	A383 Mg	4	50	75	3.45	2.71	17	4	12.84
49	A383 Mg	6	50	45	3.45	2.71	17	4	10.69
50	A383 Mg	6	50	60	3.45	2.71	17	4	11.42
51	A383 Mg	6	50	75	3.45	2.71	17	4	12.50
52	A383 Mg	8	50	45	3.45	2.71	17	4	9.96
53	A383 Mg	8	50	60	3.45	2.71	17	4	10.36
54	A383 Mg	8	50	75	3.45	2.71	17	4	10.38
55	A383 Zn	4	30	45	3.45	2.71	17	4	24.14
56	A383 Zn	4	30	60	3.45	2.71	17	4	26.38
57	A383 Zn	4	30	75	3.45	2.71	17	4	27.31
58	A383 Zn	6	30	45	3.45	2.71	17	4	23.77
59	A383 Zn	6	30	60	3.45	2.71	17	4	25.47
60	A383 Zn	6	30	75	3.45	2.71	17	4	26.64
61	A383 Zn	8	30	45	3.45	2.71	17	4	20.06
62	A383 Zn	8	30	60	3.45	2.71	17	4	21.84
63	A383 Zn	8	30	75	3.45	2.71	17	4	23.81
64	A383 Zn	4	40	45	3.45	2.71	17	4	21.34
65	A383 Zn	4	40	60	3.45	2.71	17	4	22.25
66	A383 Zn	4	40	75	3.45	2.71	17	4	24.47
67	A383 Zn	6	40	45	3.45	2.71	17	4	20.58
68	A383 Zn	6	40	60	3.45	2.71	17	4	21.41
69	A383 Zn	6	40	75	3.45	2.71	17	4	23.06
70	A383 Zn	8	40	45	3.45	2.71	17	4	18.42
71	A383 Zn	8	40	60	3.45	2.71	17	4	20.71
72	A383 Zn	8	40	75	3.45	2.71	17	4	22.65
73	A383 Zn	4	50	45	3.45	2.71	17	4	16.68
74	A383 Zn	4	50	60	3.45	2.71	17	4	20.32
75	A383 Zn	4	50	75	3.45	2.71	17	4	22.28
76	A383 Zn	6	50	45	3.45	2.71	17	4	16.26
77	A383 Zn	6	50	60	3.45	2.71	17	4	19.62
78	A383 Zn	6	50	75	3.45	2.71	17	4	21.15
		8	50	45	3.45	2.71	17	4	15.67
		8	50	60	3.45	2.71	17	4	19.13
		8	50	75	3.45	2.71	17	4	20.29
		0	30	45	3.45	2.71	17	4	24.91

83	A383	0	30	60	3.45	2.71	17	4	27.18
84	A383	0	30	75	3.45	2.71	17	4	27.80
85	A383	0	40	45	3.45	2.71	17	4	22.17
86	A383	0	40	60	3.45	2.71	17	4	23.24
87	A383	0	40	75	3.45	2.71	17	4	24.97
88	A383	0	50	45	3.45	2.71	17	4	17.14
89	A383	0	50	60	3.45	2.71	17	4	21.34
90	A383	0	50	75	3.45	2.71	17	4	23.23

Lampiran 3

Perhitungan bilangan Reynold dan *Wall Shear Stress*

Contoh perhitungan untuk bilangan Reynold dan *Wall Shear Stress* dengan kecepatan aliran 45 l/h

Diketahui : V = 45 l/h = 0.012501 m/s

D = 32 mm = 0,032 M

ρ = 1223 Kg/m^3

$\boldsymbol{\mu}$ = 1,073 x 10^{-3} Kg/m.s

Umax = 45 l/h = 0.012501 m/s

h = 32 mm = 0,032 M

y = $\frac{1}{2}$h

Ditanyakan : A. Re ?

B. τ (*wall shear stress*) ?

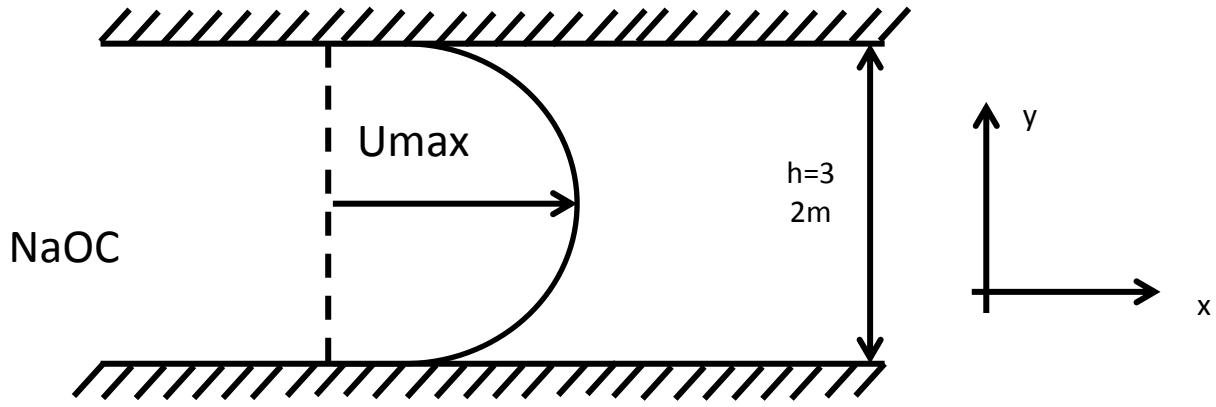
Penyelesaian :

A. $Re = \frac{V.D.\rho}{\mu}$

$Re = \frac{0.012501x0,032x1223}{1,073 \times 10^{-3}}$

$Re = 455,954$

B. $\tau = \mu \frac{du}{dy}$



$\frac{lu}{ly} \rightarrow \frac{U}{Umax} = 1 - \left(\frac{2y}{h}\right)^2$

$$\frac{du}{dy} = Umax\left(-2\left(\frac{2y}{h}\right)\left(\frac{2}{h}\right)\right) = \frac{-8\ Umax.\ y}{h^2}$$

$$\tau = \frac{-8\ \mu\ Umax\ y}{h^2}$$

$$\tau = \frac{-8(1{,}073\ x\ 10^{-3}\ \frac{kg}{m}.s)(0.012501\ m/s)(16\ x\ 10^{-3}m)}{(0{,}032\ x\ 10^{-3}m)}$$

$\tau = -0{,}00168\ N/m^2 \rightarrow$ Pada laju aliran 45 l/h

Jadi, berdasarkan arah aliran ke kanan maka nilainya menjadi $0{,}00168\ N/m^2$

Lampiran 4

Perhitungan kekuatan bending

contoh perhitungan untuk raw material A383

Diketahui : P = 851.518 (N)

L = 23 (mm)

b = 4.83 (mm)

d = 4.82 (mm)

Ditanyakan : σf ?

Penyelesaian :

$$\sigma f = \frac{3FL}{2bd^2} = \frac{3x851.518x23}{2x4.83x4.82^2}$$

$$= \frac{58754.742}{224.424}$$

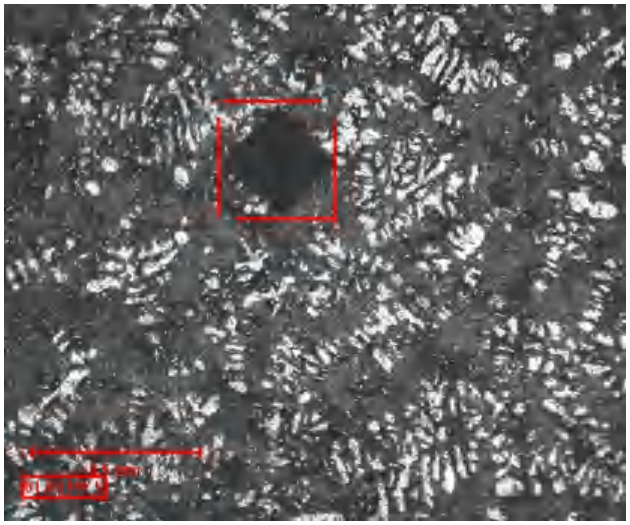
$$\sigma f = 261.80\ (N/mm^2)$$

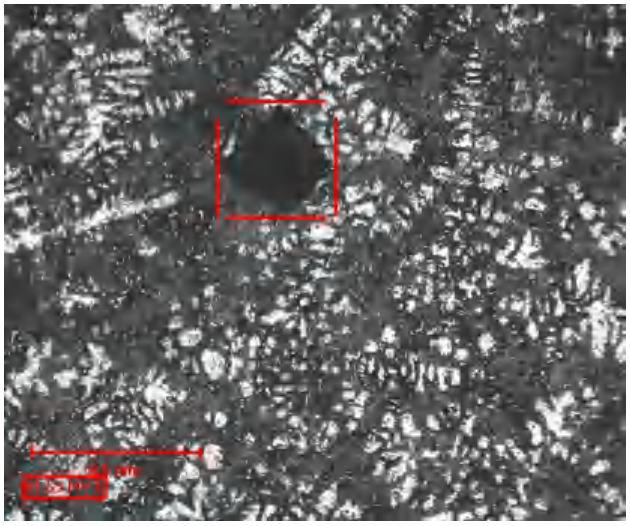
Material	F	L	B	D	σb
	(N)	(mm)	(mm)	(mm)	(N/mm^2)
A 383	851.518	23	4.83	4.82	261.80
A 383 Cu4%	1315.11	23	4.99	4.84	388.14
A 383 Cu6%	1455.06	23	4.76	5.01	420.16
A 383 Cu8%	1722.94	23	5.12	5	464.39
A 383 Mg4%	1403.63	23	6.26	5.23	282.81
A 383 Mg6%	1172.67	23	5.11	4.68	361.48
A 383 Mg8%	1255.67	23	4.81	4.96	366.09
A 383 Zn4%	1421.21	23	4.8	4.94	418.58
A 383 Zn6%	1492.18	23	4.93	4.87	440.29
A 383 Zn8%	1561.35	23	4.99	4.76	476.44

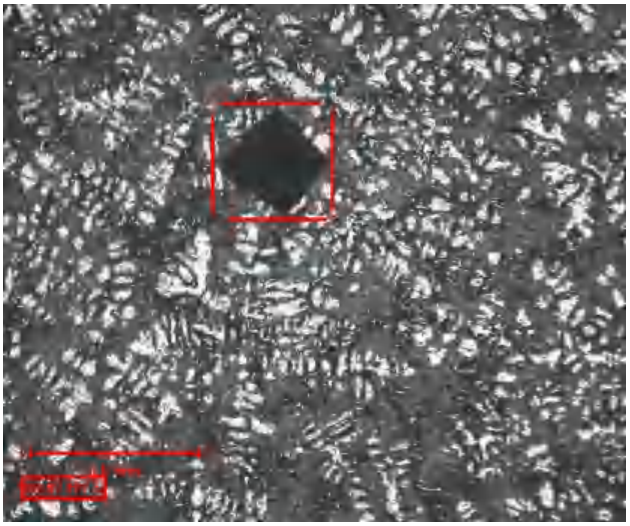
Lampiran 5

Hasil pengujian kekerasan

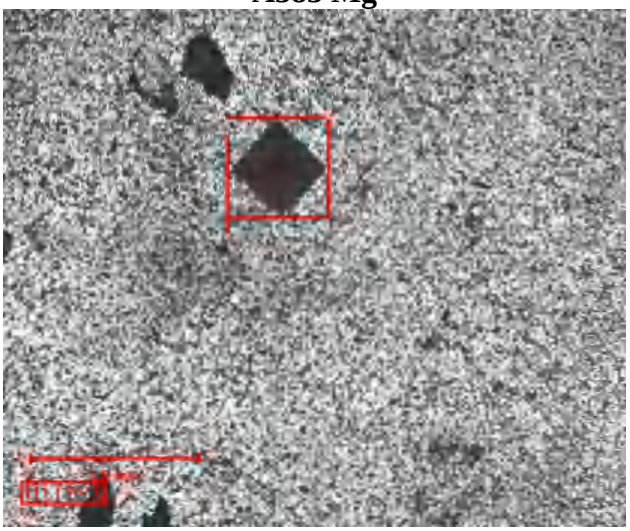
A383

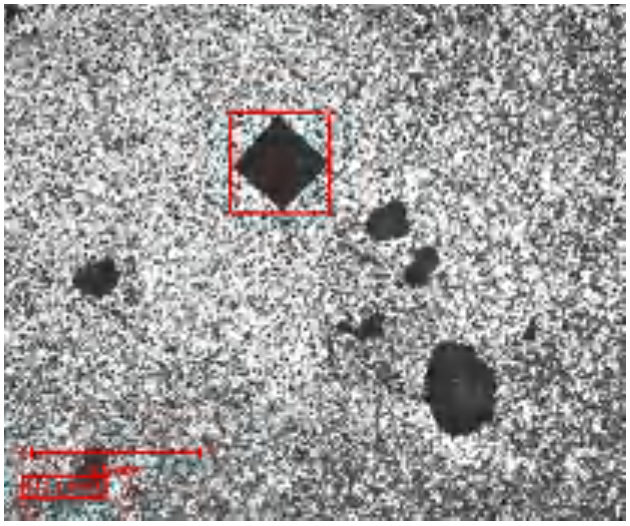


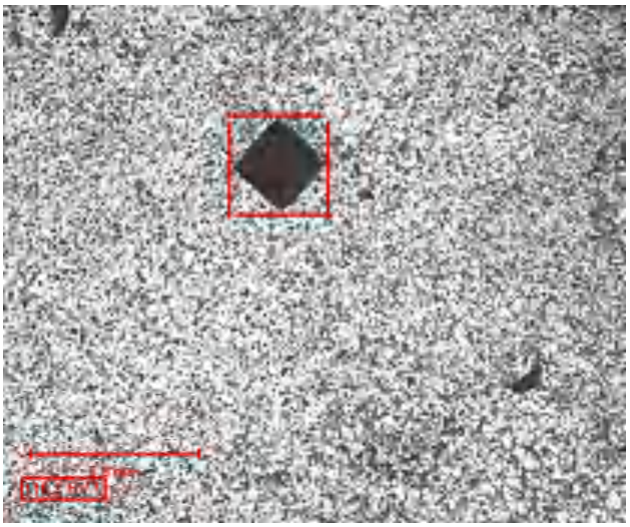




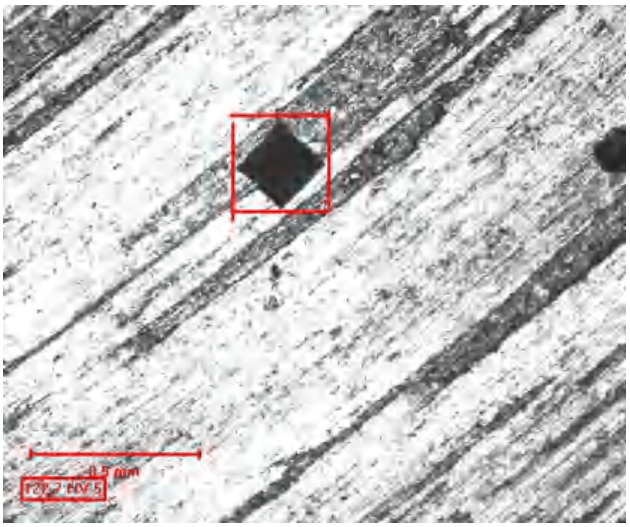
A383 Mg

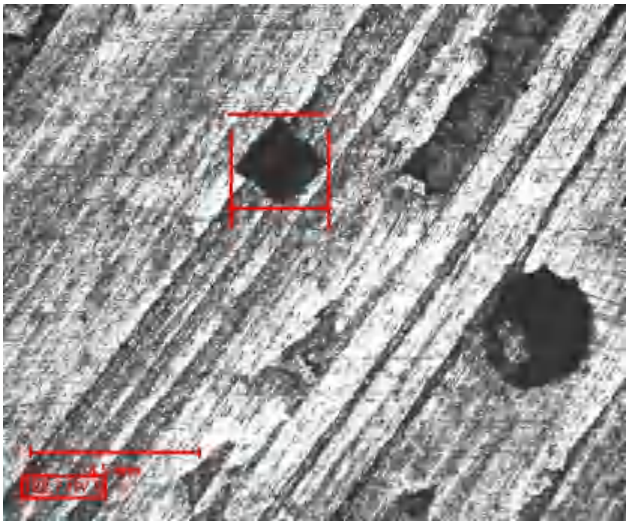


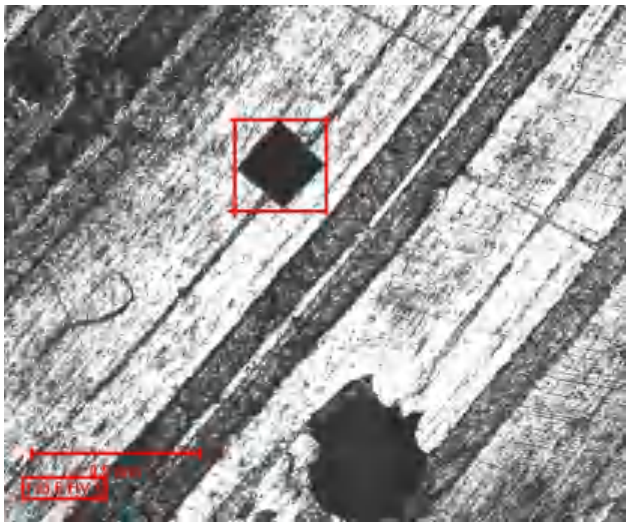




A383 Zn







A383 Mg