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LAMPIRAN

Lampiran 1 Dokumentasi kegiatan penelitian

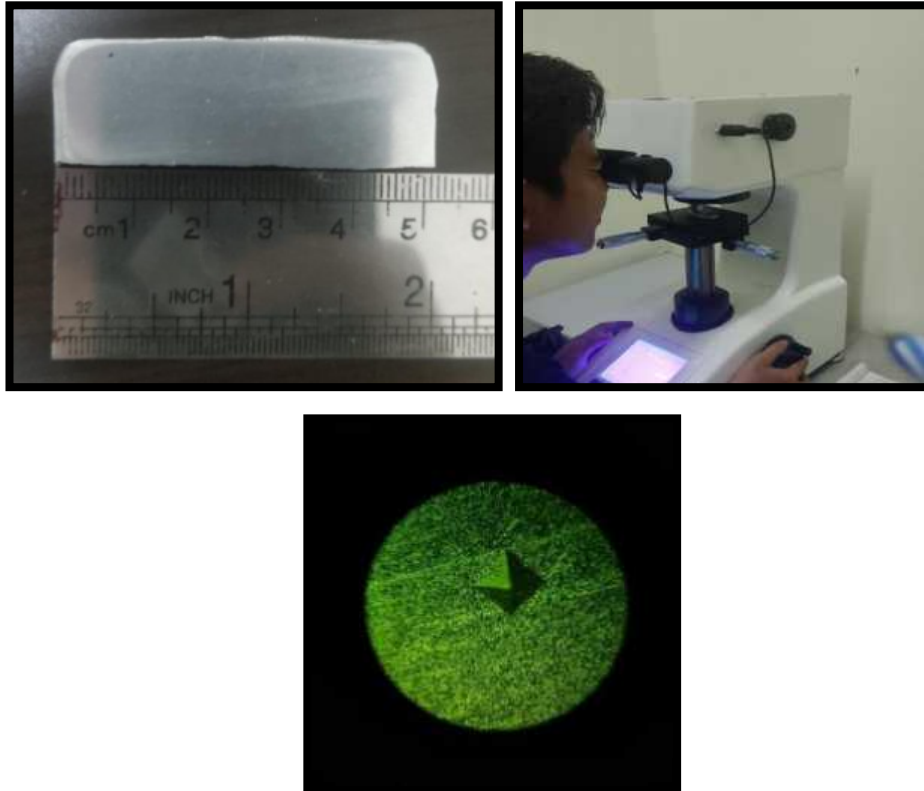
GAMBAR A.1 proses pengecoran/pembuatan specimen







GAMBAR A.2 Pengujian kekerasan



GAMBAR A.3 Pengujian Tarik



GAMBAR A.4 Pengujian komposisi

The figure consists of four photographs of a handheld device screen displaying chemical composition analysis results. The top two images show the results for AA-2024, and the bottom two images show the results for AA-2011. In each image, a specific element is highlighted in red.

AA-2024 Results (Top Left Image):

ELEMENT	% T	+/-	LIMIT
Al	91.74	0.422	90.00 - 96.00
Cu	4.86	0.030	3.80 - 4.90
Mg	1.65	0.257	1.20 - 1.80
Mn	0.57	0.021	0.30 - 0.90
Si	0.51	0.043	0.00 - 0.50
Fe	0.38	0.017	0.00 - 0.50
Zn	0.19	0.005	0.00 - 0.25
S	0.09	0.016	

AA-2024 Results (Top Right Image):

ELEMENT	% T	+/-	LIMIT
Al	92.00	0.430	90.00 - 96.00
Cu	5.08	0.031	3.80 - 4.90
Mg	1.46	0.286	1.20 - 1.80
Mn	0.82	0.026	0.30 - 0.90
Si	0.23	0.036	0.00 - 0.50
Fe	0.22	0.014	0.00 - 0.50
Zn	0.18	0.005	0.00 - 0.25
Ni	0.00	0.002	0.00 - 1.00

AA-2011 Results (Bottom Left Image):

ELEMENT	% T	+/-	LIMIT
Al	90.83	0.401	91.00 - 95.00
Cu	5.07	0.029	5.00 - 6.00
Mg	2.15	0.252	
Si	0.92	0.046	
Mn	0.61	0.021	
Fe	0.24	0.013	0.00 - 0.70
Zn	0.18	0.005	0.00 - 0.30
Ni	0.00	0.002	0.00 - 1.00

AA-2011 Results (Bottom Right Image):

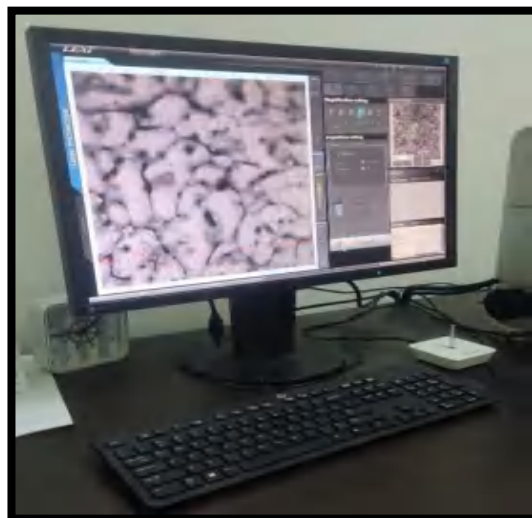
ELEMENT	% T	+/-	LIMIT
Al	91.57	0.402	91.00 - 95.00
Cu	4.84	0.028	5.00 - 6.00
Mg	2.14	0.253	
Mn	0.75	0.023	
Si	0.32	0.037	
Fe	0.22	0.013	0.00 - 0.70
Zn	0.17	0.005	0.00 - 0.30
Ni	0.00	0.002	0.00 - 1.00



GAMBAR A.5 Pengujian porositas



GAMBAR A.6 Pengamatan metalografi

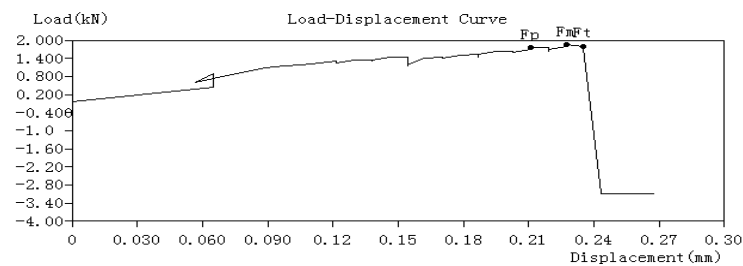


Lampiran 2 Tabel grafik pengujian Tarik

GAMBAR B.1 AL-CUDONNY

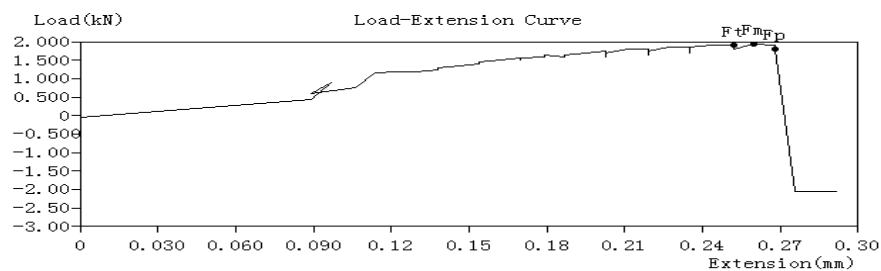
AL+CU A

Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Package No		Type	Circle
Size (mm)	6.85	So (mm ²)	36.85
Lo (mm)	11.69	Lu (mm)	
A (%)	/	Su (mm ²)	/
Z (%)	/	Fm (kN)	1.850
Rm (MPa)	50	FeH (kN)	/
ReH (MPa)	/	FeL (kN)	/
ReL (MPa)	/	Fp (kN)	1.750
Rp (MPa)	47	Ft (kN)	1.800
Rt (MPa)	49	E (GPa)	30

DONNY

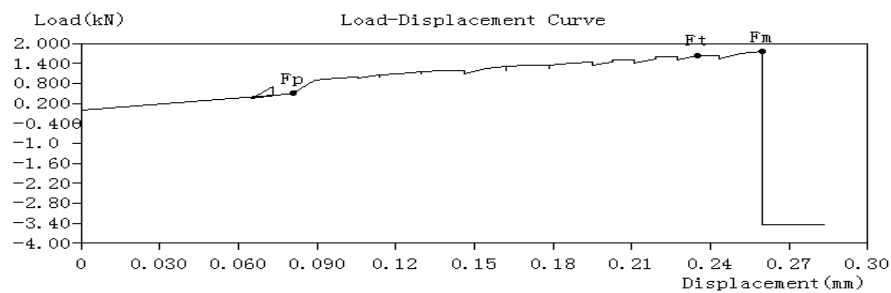
AL+CU B

Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Package No		Type	Circle
Size (mm)	6.63	So (mm ²)	34.52
Lo (mm)	10.93	Lu (mm)	
A (%)	/	Su (mm ²)	/
Z (%)	/	Fm (kN)	1.950
Rm (MPa)	56	FeH (kN)	/
ReH (MPa)	/	FeL (kN)	/
ReL (MPa)	/	Fp (kN)	1.800
Rp (MPa)	52	Ft (kN)	1.900
Rt (MPa)	55	E (GPa)	23



DONNY
AL+CU C

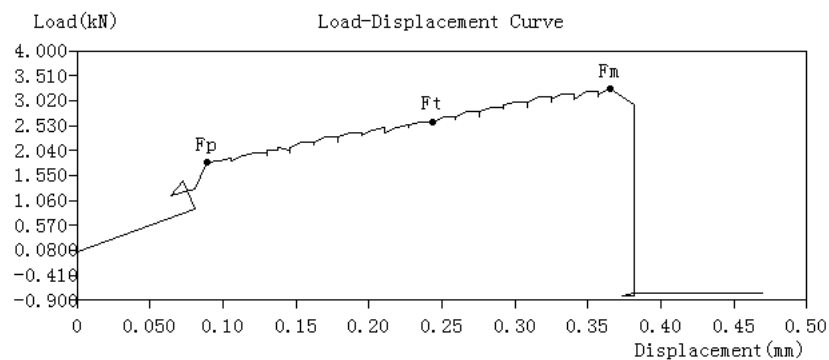
Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Packet No		Type	Circle
Size (mm)	6.87	So (mm ²)	37.07
Lo (mm)	9.21	Lu (mm)	
A (%)	/	Su (mm ²)	/
Z (%)	/	F _m (kN)	1.750
R _m (MPa)	47	F _{eH} (kN)	/
ReH (MPa)	/	F _{eL} (kN)	/
ReL (MPa)	/	F _p (kN)	/
R _p (MPa)	/	F _t (kN)	1.650
R _t (MPa)	45	E (GPa)	/



Gambar B.2 variasi penambahan CNT 1%

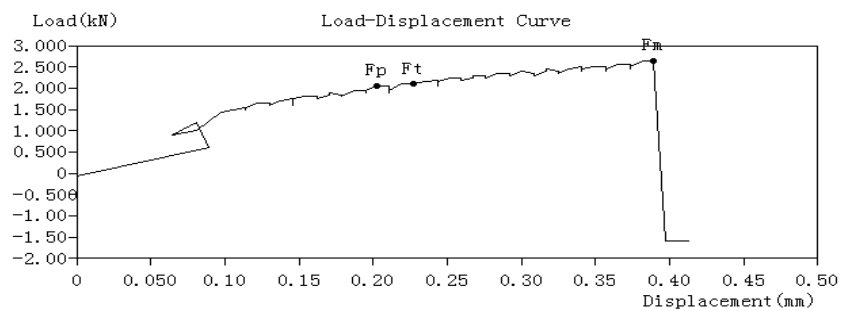
DONNY
CNT 1% A

Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Packet No		Type	Circle
Size (mm)	6.60	So (mm ²)	34.21
Lo (mm)	8.42	Lu (mm)	
A (%)	/	Su (mm ²)	/
Z (%)	/	F _m (kN)	3.250
R _m (MPa)	95	F _{eH} (kN)	/
ReH (MPa)	/	F _{eL} (kN)	/
ReL (MPa)	/	F _p (kN)	1.800
R _p (MPa)	53	F _t (kN)	2.600
R _t (MPa)	76	E (GPa)	/



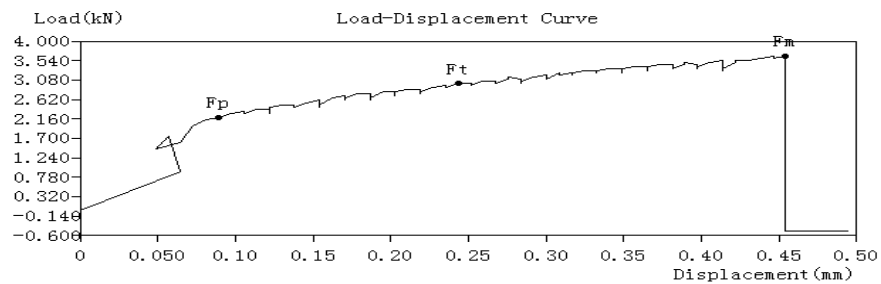
DONNY
CNT 1% B

Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Package No		Type	Circle
Size (mm)	6.60	So (mm ²)	34.21
Lo (mm)	8.27	Lu (mm)	
A (%)	/	Su (mm ²)	/
Z (%)	/	F _m (kN)	2.650
R _m (MPa)	77	FeH (kN)	/
ReH (MPa)	/	FeL (kN)	/
ReL (MPa)	/	F _p (kN)	2.050
R _p (MPa)	60	F _t (kN)	2.100
R _t (MPa)	61	E (GPa)	/



DONNY
CNT 1% C

Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Package No		Type	Circle
Size (mm)	6.84	So (mm ²)	36.75
Lo (mm)	13.20	Lu (mm)	
A (%)	/	Su (mm ²)	/
Z (%)	/	F _m (kN)	3.650
R _m (MPa)	99	FeH (kN)	/
ReH (MPa)	/	FeL (kN)	/
ReL (MPa)	/	F _p (kN)	2.200
R _p (MPa)	60	F _t (kN)	3.000
R _t (MPa)	82	E (GPa)	/

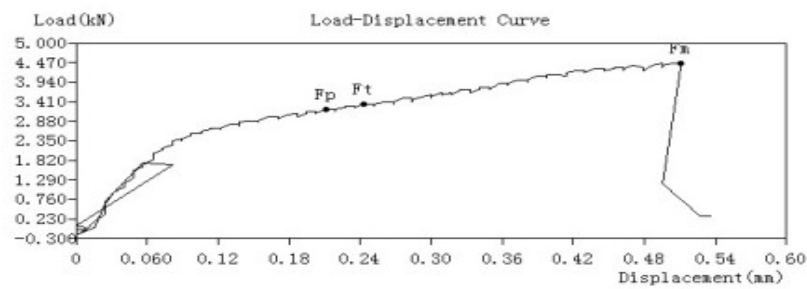


Gambar B.3 variasi penambahan 1,5% CNT

DONNY

CNT 1.5% A

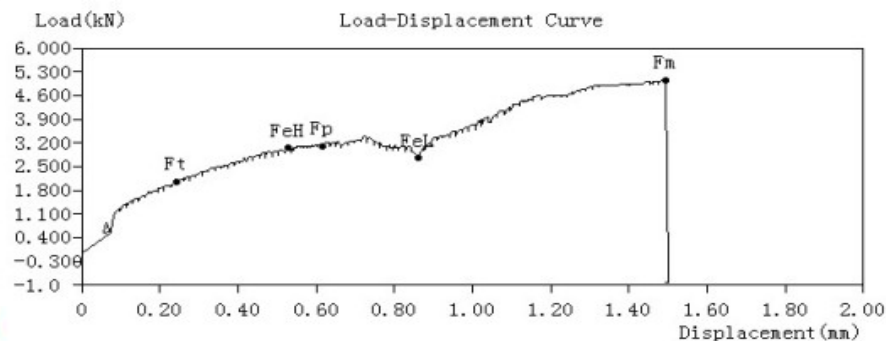
Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Packet No		Type	Circle
Size (mm)	6.40	So (mm ²)	32.17
Lo (mm)	11.16	Lu (mm)	
A (%)	/	Su (mm ²)	/
Z (%)	/	F _m (kN)	4.450
R _m (MPa)	138	FeH (kN)	/
ReH (MPa)	/	FeL (kN)	/
ReL (MPa)	/	F _p (kN)	3.200
R _p (MPa)	99	F _t (kN)	3.350
R _t (MPa)	104	E (GPa)	42



DONNY

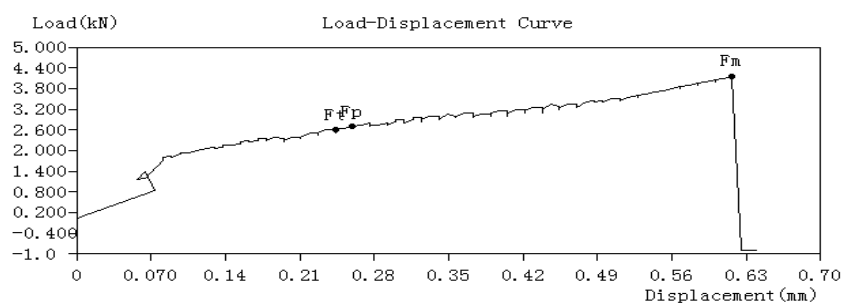
CNT 1.5% B

Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Packet No		Type	Circle
Size (mm)	6.50	So (mm ²)	33.18
Lo (mm)	13.23	Lu (mm)	
A (%)	/	Su (mm ²)	/
Z (%)	/	F _m (kN)	5.050
R _m (MPa)	152	FeH (kN)	3.050
ReH (MPa)	92	FeL (kN)	2.750
ReL (MPa)	83	F _p (kN)	3.100
R _p (MPa)	93	F _t (kN)	2.050
R _t (MPa)	62	E (GPa)	6



DONNY
CNT 1.5% C

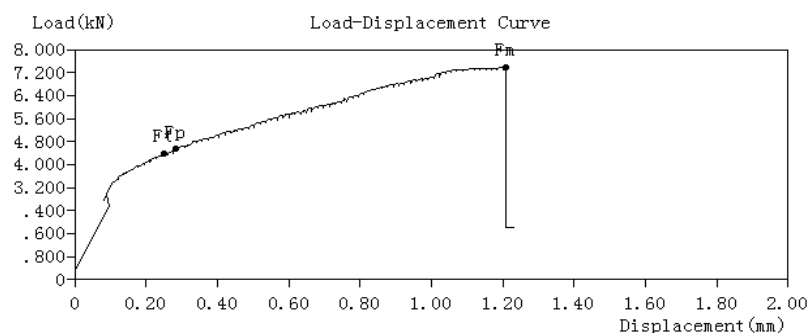
Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Package No		Type	Circle
Size(mm)	6.46	So(mm ²)	32.78
Lo(mm)	6.60	Lu(mm)	
A(%)	/	Su(mm ²)	/
Z(%)	/	Fm(kN)	4.150
Rm(MPa)	127	FeH(kN)	/
ReH(MPa)	/	FeL(kN)	/
ReL(MPa)	/	Fp(kN)	2.700
Rp(MPa)	82	Ft(kN)	2.600
Rt(MPa)	79	E(GPa)	22



Gambar B.4 variasi penambahan 2% CNT

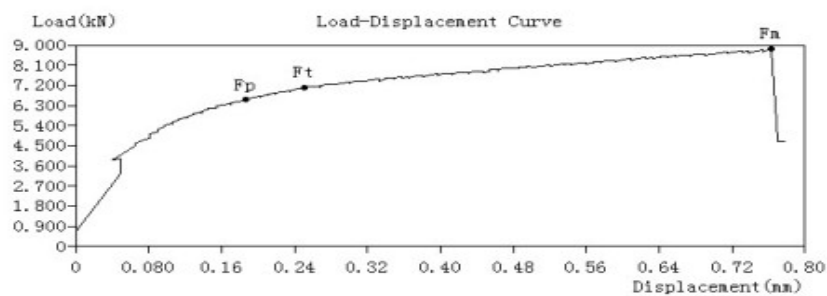
DONNY
CNT 2%

Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Package No		Type	Circle
Size(mm)	6.0	So(mm ²)	28.27
Lo(mm)	10	Lu(mm)	
A(%)	/	Su(mm ²)	/
Z(%)	/	Fm(kN)	7.400
Rm(MPa)	262	FeH(kN)	/
ReH(MPa)	/	FeL(kN)	/
ReL(MPa)	/	Fp(kN)	4.550
Rp(MPa)	161	Ft(kN)	4.400
Rt(MPa)	156	E(GPa)	31



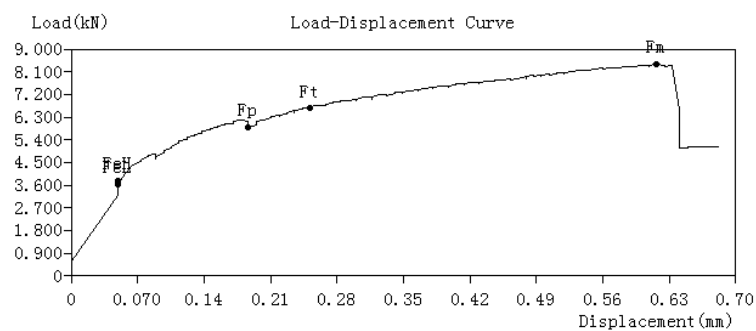
DONNY
CNT 2% B

Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Packet No		Type	Circle
Size(mm)	6.40	So(mm ²)	32.17
Lo(mm)	8.77	Lu(mm)	
A(%)	/	Su(mm ²)	/
Z(%)	/	Fm(kN)	8.850
Rm(MPa)	275	FeH(kN)	/
ReH(MPa)	/	FeL(kN)	/
ReL(MPa)	/	Fp(kN)	6.550
Rp(MPa)	204	Ft(kN)	7.100
Rt(MPa)	221	E(GPa)	131



DONNY
CNT 2% C

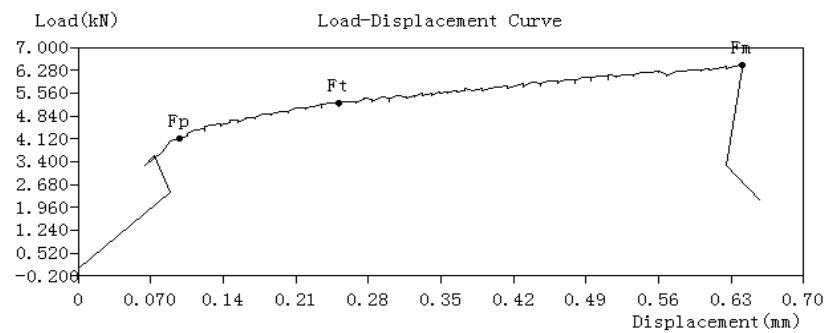
Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Packet No		Type	Circle
Size(mm)	6.61	So(mm ²)	34.32
Lo(mm)	9.44	Lu(mm)	
A(%)	/	Su(mm ²)	/
Z(%)	/	Fm(kN)	8.400
Rm(MPa)	245	FeH(kN)	3.800
ReH(MPa)	111	FeL(kN)	3.650
ReL(MPa)	106	Fp(kN)	5.900
Rp(MPa)	172	Ft(kN)	6.650
Rt(MPa)	194	E(GPa)	87



Gambar B.5 variasi penambahan 1% CNT + Mg 2%DONNY

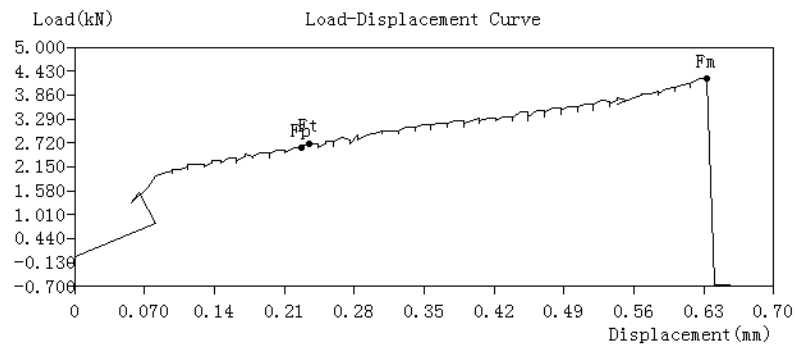
CNT 1% + Mg 2% A

Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Package No		Type	Circle
Size(mm)	6.63	So(mm ²)	34.52
Lo(mm)	11.43	Lu(mm)	
A(%)	/	Su(mm ²)	/
Z(%)	/	Fm(kN)	6.450
Rm(MPa)	187	FeH(kN)	/
ReH(MPa)	/	FeL(kN)	/
ReL(MPa)	/	Fp(kN)	4.150
Rp(MPa)	120	Ft(kN)	5.250
Rt(MPa)	152	E(GPa)	/

DONNY

CNT 1% + Mg 2% B

Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Package No		Type	Circle
Size(mm)	6.73	So(mm ²)	35.57
Lo(mm)	7.38	Lu(mm)	
A(%)	/	Su(mm ²)	/
Z(%)	/	Fm(kN)	4.250
Rm(MPa)	119	FeH(kN)	/
ReH(MPa)	/	FeL(kN)	/
ReL(MPa)	/	Fp(kN)	2.600
Rp(MPa)	73	Ft(kN)	2.700
Rt(MPa)	76	E(GPa)	33

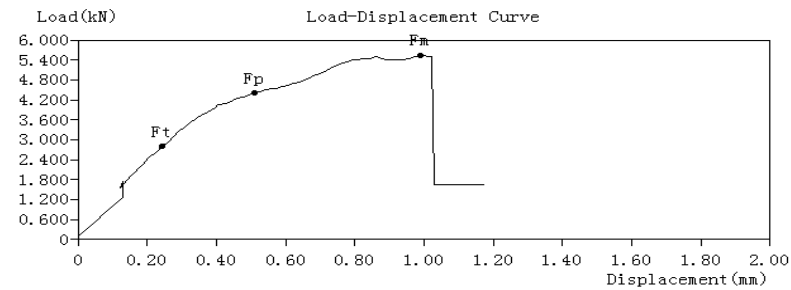


Gambar B.6 variasi penambahan 1.5% CNT + Mg 3%

ALUMINIUM 2024

CNT 1.5% + Mg 3% A

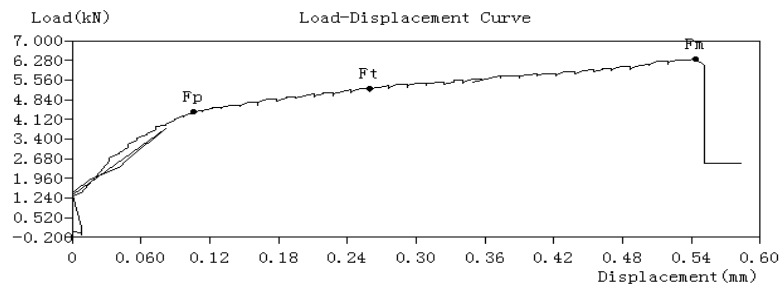
Customer	MHS S1	TestDate	2023/8/16 星期三
Coil No/Package No		Type	Circle
Size (mm)	6	So (mm ²)	28.27
Lo (mm)	10	Lu (mm)	
A (%)	/	Su (mm ²)	/
Z (%)	/	Fm (kN)	5.550
Rm (MPa)	196	FeH (kN)	/
ReH (MPa)	/	FeL (kN)	/
ReL (MPa)	/	Fp (kN)	4.400
Rp (MPa)	156	Ft (kN)	2.800
Rt (MPa)	99	E (GPa)	17



DONNY

CNT 1.5% + Mg 3% B

Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Package No		Type	Circle
Size (mm)	6.70	So (mm ²)	35.26
Lo (mm)	10.14	Lu (mm)	
A (%)	/	Su (mm ²)	/
Z (%)	/	Fm (kN)	6.350
Rm (MPa)	180	FeH (kN)	/
ReH (MPa)	/	FeL (kN)	/
ReL (MPa)	/	Fp (kN)	4.400
Rp (MPa)	125	Ft (kN)	5.250
Rt (MPa)	149	E (GPa)	/

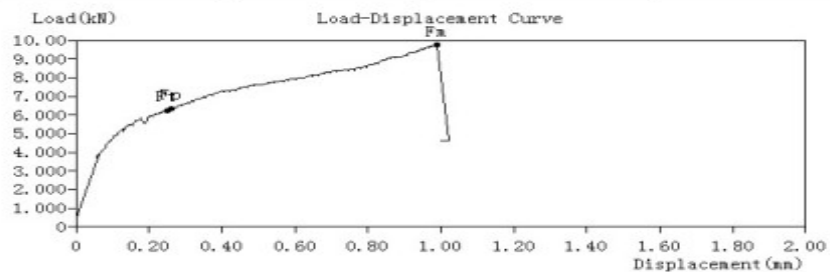


Gambar B.7 variasi penambahan 2% CNT + Mg 4%

DONNY

CNT 2% + Mg 4% A

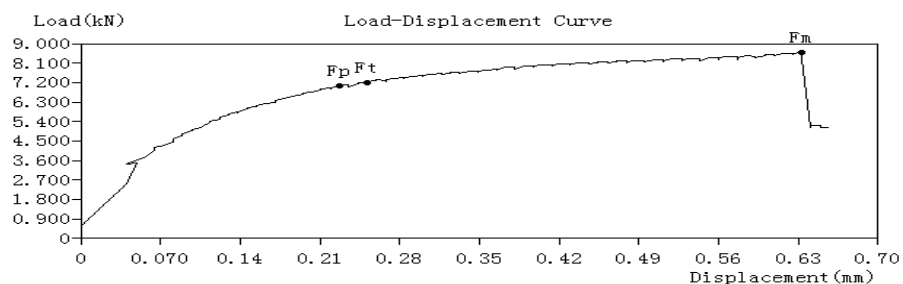
Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Packet No		Type	Circle
Size(mm)	6.50	So(mm ²)	33.18
Lo(mm)	12.31	Lu(mm)	
A(%)	/	Su(mm ²)	/
Z(%)	/	Fa(kN)	9.750
Rm(MPa)	294	FeH(kN)	/
ReH(MPa)	/	FeL(kN)	/
ReL(MPa)	/	Fp(kN)	6.350
Rp(MPa)	191	Ft(kN)	6.250
Rt(MPa)	188	E(GPa)	38



DONNY

CNT 2% + Mg 4% B

Customer	DONNY	TestDate	2023/8/31 星期四
Coil No/Packet No		Type	Circle
Size(mm)	6.26	So(mm ²)	30.78
Lo(mm)	13.92	Lu(mm)	
A(%)	/	Su(mm ²)	/
Z(%)	/	Fm(kN)	8.600
Rm(MPa)	279	FeH(kN)	/
ReH(MPa)	/	FeL(kN)	/
ReL(MPa)	/	Fp(kN)	7.050
Rp(MPa)	229	Ft(kN)	7.200
Rt(MPa)	234	E(GPa)	77



CNT 2% + Mg 4% 2

SampleID	CNT 2% + Mg 4% 2	TestDate	24/9/2023
Operator	DONNY	Type	Circle
Size(mm)	6.40	So(mm ²)	32.17
Lo(mm)	150	Fbc(kN)	7.25
Rbc(MPa)	225	Fsc(kN)	/
Rsc(MPa)	/	Fpc(kN)	4.30
Rpc(MPa)	134	Ftc(kN)	/
Rtc(MPa)	/	Ec(GPa)	4.83

