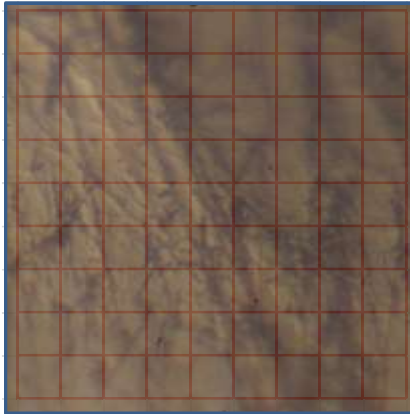


LAMPIRAN

Perhitungan Persentase Ferit Perlit Struktur Mikro

Temperature 700°C Hold.Time 45 menit

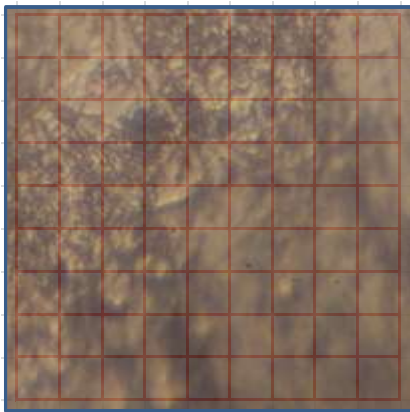
- **Logam Induk**



$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$
$$\frac{28}{100} \times 100\% = 28 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$
$$100\% - 28 = 72 \%$$

- **HAZ**



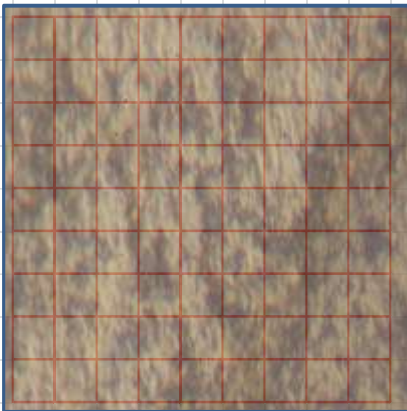
Persentase Perlit : $\frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$
 $\frac{61}{100} \times 100\% = 61 \%$

Persentase Ferit : $100\% - \text{Persentase Perlit} = \%$

$100\% - 61 = 39 \%$

- **Logam Las**

-



Persentase Perlit : $\frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$
 $\frac{60}{100} \times 100\% = 60 \%$

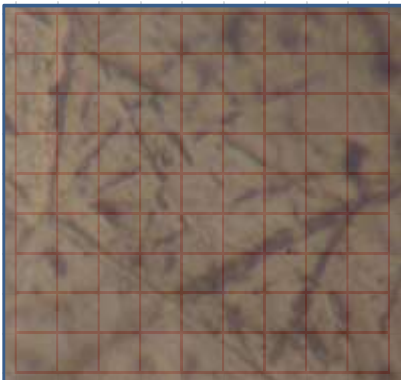
Persentase Ferit : $100\% - \text{Persentase Perlit} = \%$

$100\% - 60 = 40 \%$

Temperature 700°C Hold. Time 70 menit

- **Logam Induk**

-



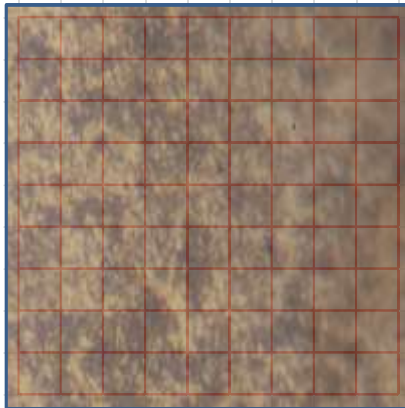
$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{21}{100} \times 100\% = 21 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 21 = 79 \%$$

- **HAZ**



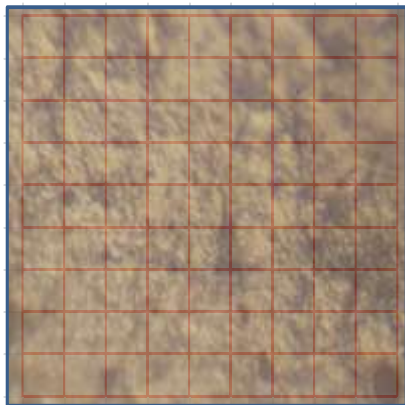
$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{59}{100} \times 100\% = 59 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 59 = 41 \%$$

- **Logam Las**



$$\text{Persentase Perlit : } \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

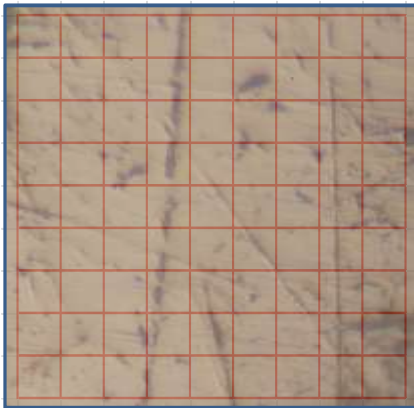
$$\frac{57}{100} \times 100\% = 57 \%$$

$$\text{Persentase Ferit : } 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 57 = 43 \%$$

Temperature 700°C Hold.Time 95 menit

- **Logam Induk**



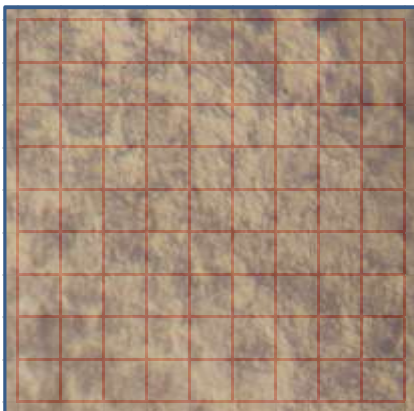
$$\text{Persentase Perlit : } \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{20}{100} \times 100\% = 20 \%$$

$$\text{Persentase Ferit : } 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 20 = 80 \%$$

- **HAZ**



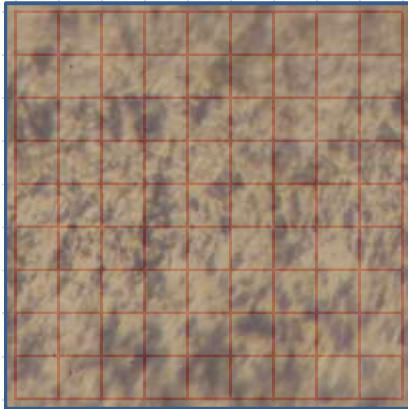
$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{55}{100} \times 100\% = 55 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 55 = 45 \%$$

- **Logam Las**



$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

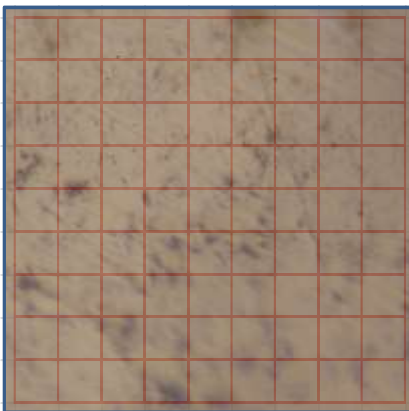
$$\frac{53}{100} \times 100\% = 53 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 53 = 47 \%$$

Temperature 750°C Hold. Time 45 menit

- **Logam Induk**



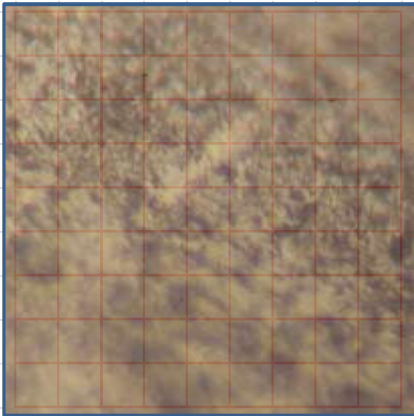
$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{18}{100} \times 100\% = 18 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 18 = 82 \%$$

- **HAZ**



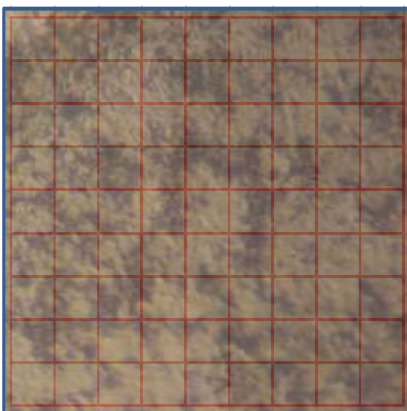
$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{51}{100} \times 100\% = 51 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 51 = 49 \%$$

- **Logam Las**



$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

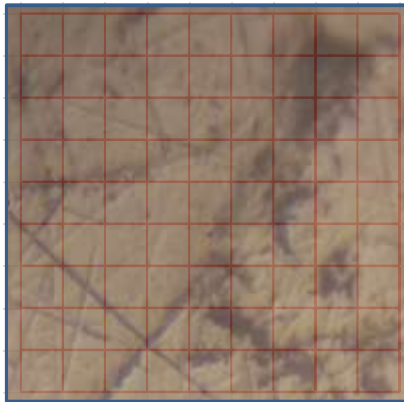
$$\frac{52}{100} \times 100\% = 52 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 52 = 48 \%$$

Temperature 750°C Hold.Time 70 menit

- **Logam Induk**



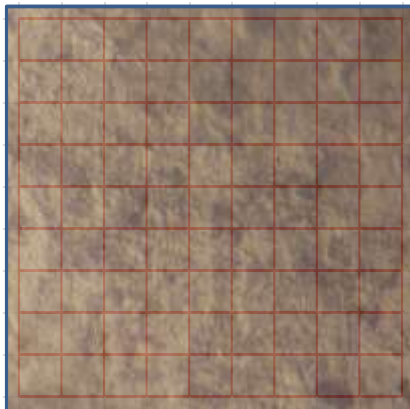
$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{15}{100} \times 100\% = 15 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 15 = 85 \%$$

- **HAZ**



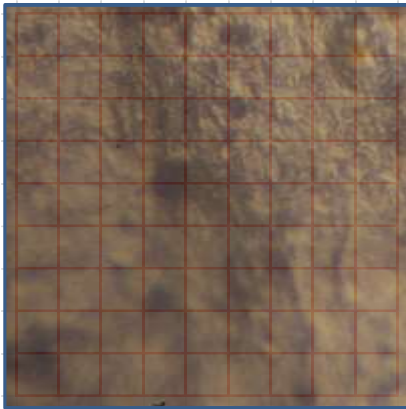
$$\text{Persentase Perlit : } \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{29}{100} \times 100\% = 29 \%$$

$$\text{Persentase Ferit : } 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 29 = 71 \%$$

- **Logam Las**



$$\text{Persentase Perlit : } \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

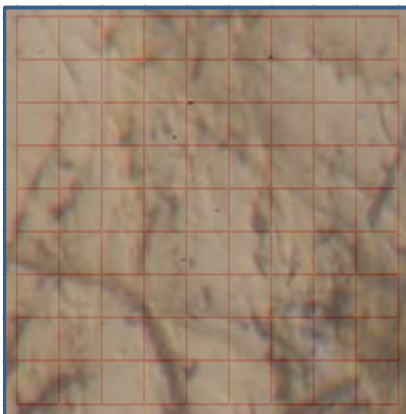
$$\frac{22}{100} \times 100\% = 22 \%$$

$$\text{Persentase Ferit : } 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 22 = 77 \%$$

Temperature 750°C Hold. Time 95 menit

- **Logam Induk**



$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{14}{100} \times 100\% = 14 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 14 = 86 \%$$

- **HAZ**



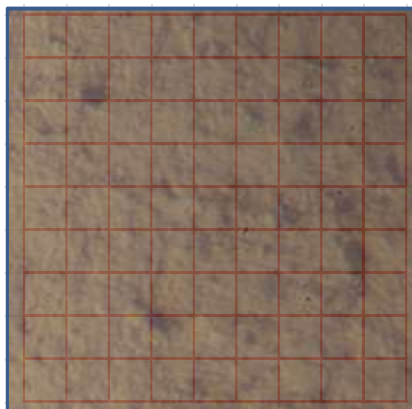
$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{27}{100} \times 100\% = 27 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 27 = 73 \%$$

- **Logam Las**



$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

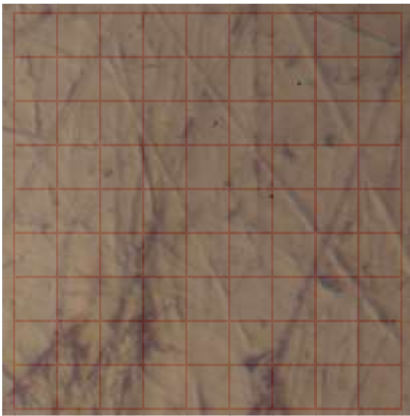
$$\frac{21}{100} \times 100\% = 21 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 21 = 79 \%$$

Temperature 800°C Hold.Time 45 menit

- **Logam Induk**



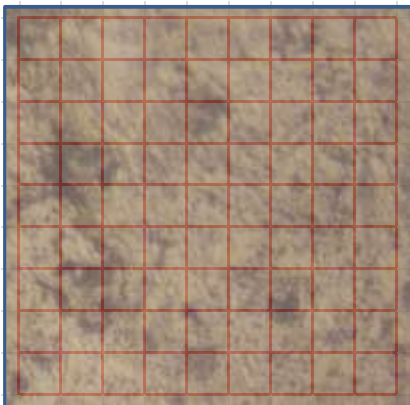
$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{12}{100} \times 100\% = 12 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 12 = 88 \%$$

- **HAZ**



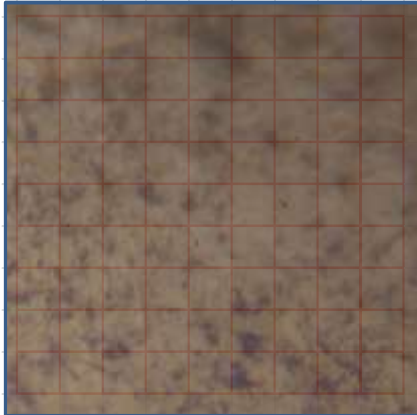
$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{26}{100} \times 100\% = 26 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 26 = 74 \%$$

- **Logam Las**



$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

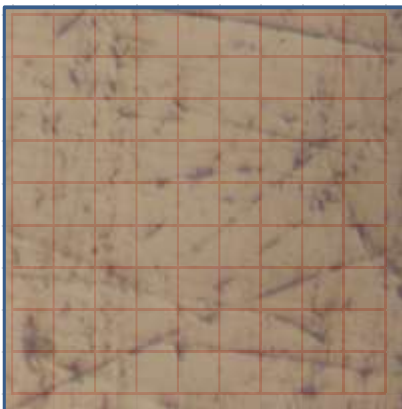
$$\frac{21}{100} \times 100\% = 21 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 21 = 79 \%$$

Temperature 800°C Hold. Time 70 menit

- **Logam Induk**



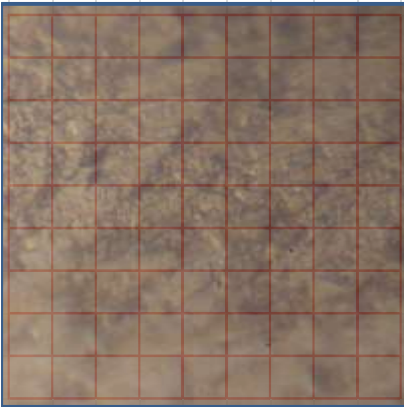
$$\text{Persentase Perlit : } \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{11}{100} \times 100\% = 11 \%$$

$$\text{Persentase Ferit : } 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 11 = 89 \%$$

- **HAZ**



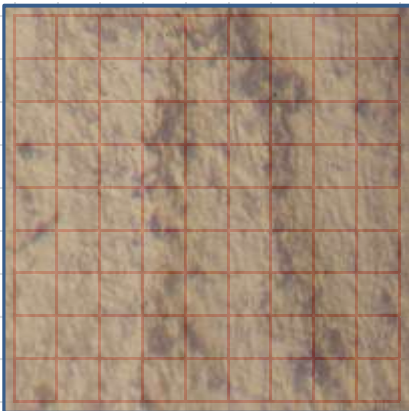
$$\text{Persentase Perlit : } \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{22}{100} \times 100\% = 22 \%$$

$$\text{Persentase Ferit : } 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 22 = 78 \%$$

- **Logam Las**



$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{19}{100} \times 100\% = 19 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 19 = 81 \%$$

Temperature 800°C Hold. Time 95 menit

- **Logam Induk**



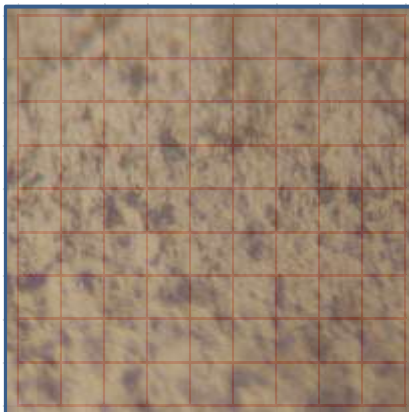
$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{11}{100} \times 100\% = 11 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 11 = 89 \%$$

- **HAZ**



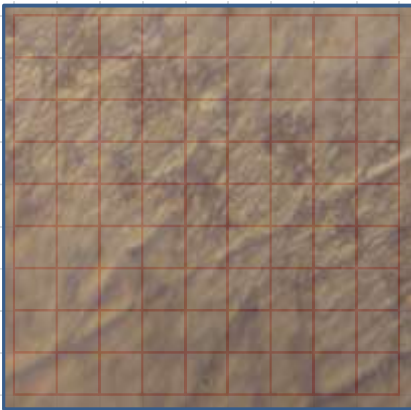
$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{17}{100} \times 100\% = 17 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 17 = 83 \%$$

- **Logam Las**



$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

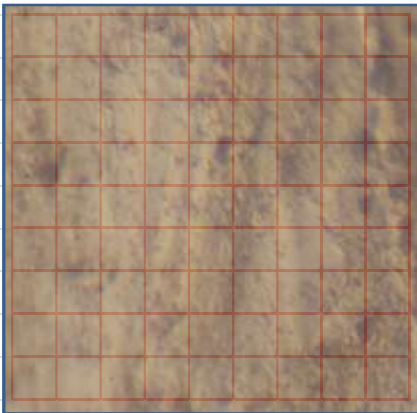
$$\frac{13}{100} \times 100\% = 13 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 13 = 87 \%$$

Tanpa PWHT

- **Logam Induk**



$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{34}{100} \times 100\% = 34 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 34 = 66 \%$$

- **HAZ**



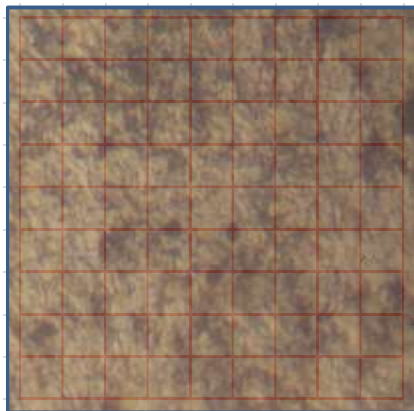
$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{65}{100} \times 100\% = 65 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 65 = 35 \%$$

- **Logam Las**



$$\text{Persentase Perlit} : \frac{\text{jumlah fasa perlit}}{\text{jumlah titik}} \times 100\% = \%$$

$$\frac{60}{100} \times 100\% = 60 \%$$

$$\text{Persentase Ferit} : 100\% - \text{Persentase Perlit} = \%$$

$$100\% - 60 = 40 \%$$

- **Menghitung Impact Strength (Harga Impact)**

Diketahui :

$$A = 80 \text{ mm}^2$$

$$m = 26,08 \text{ kg}$$

$$\alpha_1 = 110^\circ$$

$$\alpha_2 = \text{sudut setelah pembebanan}$$

$$l = 0,7500 \text{ m}$$

$$W = m \cdot g = 26,08 \text{ kg} \times 9,8 \text{ m/s}^2$$

$$= 255,8 \text{ N}$$

$$E = W \cdot l (\cos \alpha^2 - \cos \alpha^1) \text{ (J)}$$

$$HI = \frac{E}{A} \text{ (Joule/mm}^2\text{)}$$

- **Perhitungan temperature 700°C holding time 45 menit**

$$E = W \cdot l (\cos \alpha_2 - \cos \alpha_1)$$

$$= 255,8 \times 0,75 (\cos 73 - \cos 110)$$

$$= 191,85 \times 0,634$$

$$= \mathbf{121,632 \text{ J}}$$

$$HI = \frac{E}{A}$$

$$= \frac{121,632}{80}$$

$$= \mathbf{1,52 \text{ J/mm}^2}$$

- **Perhitungan temperature 700°C holding time 70 menit**

$$E = W \cdot l (\cos \alpha_2 - \cos \alpha_1)$$

$$= 255,8 \times 0,75 (\cos 70 - \cos 110)$$

$$= 191,85 \times 0,684$$

$$\begin{aligned}
 &= 131,225 \text{ J} \\
 H1 &= \frac{E}{A} \\
 &= \frac{131,225}{80} \\
 &= 1,64 \text{ J/mm}^2
 \end{aligned}$$

- **Perhitungan temperature 700°C holding time 95 menit**

$$\begin{aligned}
 E &= W \cdot l (\cos \alpha_2 - \cos \alpha_1) \\
 &= 255,8 \times 0,75 (\cos 69 - \cos 110) \\
 &= 191,85 \times 0,7 \\
 &= 134,295 \text{ J} \\
 H1 &= \frac{E}{A} \\
 &= \frac{134,295}{80} \\
 &= 1,67 \text{ J/mm}^2
 \end{aligned}$$

- **Perhitungan temperature 750°C holding time 45 menit**

$$\begin{aligned}
 E &= W \cdot l (\cos \alpha_2 - \cos \alpha_1) \\
 &= 255,8 \times 0,75 (\cos 63 - \cos 110) \\
 &= 191,85 \times 0,795 \\
 &= 152,52 \text{ J} \\
 H1 &= \frac{E}{A} \\
 &= \frac{152,52}{80} \\
 &= 1,906 \text{ J/mm}^2
 \end{aligned}$$

- **Perhitungan temperature 750°C holding time 70 menit**

$$\begin{aligned}
 E &= W \cdot l (\cos \alpha_2 - \cos \alpha_1) \\
 &= 255,8 \times 0,75 (\cos 61 - \cos 110) \\
 &= 191,85 \times 0,826
 \end{aligned}$$

$$\begin{aligned}
&= \mathbf{158,468 \text{ J}} \\
H1 &= \frac{E}{A} \\
&= \frac{158,468}{80} \\
&= \mathbf{1,98 \text{ J/mm}^2}
\end{aligned}$$

- **Perhitungan temperature 750⁰C holding time 95 menit**

$$\begin{aligned}
E &= W \cdot l (\cos \alpha_2 - \cos \alpha_1) \\
&= 255,8 \times 0,75 (\cos 59 - \cos 110) \\
&= 191,85 \times 0,857 \\
&= \mathbf{164,415 \text{ J}} \\
H1 &= \frac{E}{A} \\
&= \frac{164,415}{80} \\
&= \mathbf{2,055 \text{ J/mm}^2}
\end{aligned}$$

- **Perhitungan temperature 800⁰C holding time 45 menit**

$$\begin{aligned}
E &= W \cdot l (\cos \alpha_2 - \cos \alpha_1) \\
&= 255,8 \times 0,75 (\cos 55 - \cos 110) \\
&= 191,85 \times 0,915 \\
&= \mathbf{175,542 \text{ J}} \\
H1 &= \frac{E}{A} \\
&= \frac{175,542}{80} \\
&= \mathbf{2,194 \text{ J/mm}^2}
\end{aligned}$$

- **Perhitungan temperature 800⁰C holding time 70 menit**

$$\begin{aligned}
E &= W \cdot l (\cos \alpha_2 - \cos \alpha_1) \\
&= 255,8 \times 0,75 (\cos 51 - \cos 110) \\
&= 191,85 \times 0,971
\end{aligned}$$

$$= 186,286 \text{ J}$$

$$\begin{aligned} H1 &= \frac{E}{A} \\ &= \frac{186,286}{80} \\ &= 2,238 \text{ J/mm}^2 \end{aligned}$$

- **Perhitungan temperature 800⁰C holding time 95 menit**

$$\begin{aligned} E &= W \cdot l (\cos \alpha_2 - \cos \alpha_1) \\ &= 255,8 \times 0,75 (\cos 47 - \cos 110) \\ &= 191,85 \times 1,023 \\ &= 196,262 \text{ J} \end{aligned}$$

$$\begin{aligned} H1 &= \frac{E}{A} \\ &= \frac{196,262}{80} \\ &= 2,453 \text{ J/mm}^2 \end{aligned}$$

- **Perhitungan tanpa perlakuan panas**

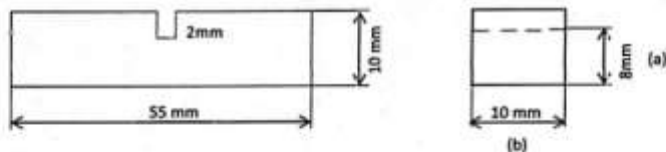
$$\begin{aligned} E &= W \cdot l (\cos \alpha_2 - \cos \alpha_1) \\ &= 255,8 \times 0,75 (\cos 78 - \cos 110) \\ &= 191,85 \times 0,549 \\ &= 105,325 \text{ J} \end{aligned}$$

$$\begin{aligned} H1 &= \frac{E}{A} \\ &= \frac{105,325}{80} \\ &= 1,316 \text{ J/mm}^2 \end{aligned}$$



Nama Mahasiswa : Nungki Dwi Putra
NBI : 1421700059
Tanggal Pengujian : 3 Mei 2021

DATA HASIL PENELITIAN PENGUJIAN IMPACT



a = Tinggi section dibawah takik

b = Lebar sampel (mm)

A = Luas penampang dibawah takik (a x b)

Material : ST.41

Metode : Charpy

Beban Impact : 26,08 kg

No	Bahan	Temp. PWHT (°C)	Holding Time (menit)	T (°C)	a (mm)	b (mm)	A (mm ²)	a ₁ (°)	a ₂ (°)	Bentuk Patahan
1	Baja ST.41	700	45	30	8	10	80	110	73	Geray
2		700	70	30	8	10	80	110	70	Geray
3		700	95	30	8	10	80	110	69	Geray
4		750	45	30	8	10	80	110	63	Geray
5		750	70	30	8	10	80	110	61	Ulet



6	Baja St.41	750	95	30	8	60	80	110	59	Ulet
7		800	45	30	8	60	80	110	55	Ulet
8		800	70	30	8	60	80	110	51	Ulet
9		800	95	30	8	60	80	110	47	Ulet
10		-	-	30	8	10	80	110	78	Getas

Surabaya, 5 Mei 2021

AsLab. Material



(Mulyadi)



SURAT KETERANGAN

Yang bertanda tangan dibawah ini menerangkan bahwa:

Nama : Nungki Dwi Putra
NBI : 1421700054
Jurusan : Teknik Mesin – Universitas 17 Agustus 1945 Surabaya

Telah selesai melakukan penelitian uji struktur mikro di Laboratorium Material Teknik Mesin
Fakultas Teknik Universitas 17 Agustus 1945 Surabaya pada tanggal 3 Mei 2021.
Demikian surat keterangan ini dibuat untuk digunakan sebagaimana mestinya.

Surabaya, 5 Mei 2021

AsLab. Material



	Laboratorium Pengujian Bahan & Pelapisan Logam Jurusan Teknik Mesin - Fakultas Teknik Universitas Negeri Surabaya
	Perlakuan Panas (Heat Treatment) Nabertherm Furnace

Dibawah ini menerangkan bahwa:

No	Nama Mahasiswa	NBI	Email	No. HP
1.	Nungki Dwi Putra	1421700054	nungkiputra52543@gmail.com	85899752974
2.	Dimas Ruseno	1421700104	dimasrusena@gmail.com	82338653675

Telah menggunakan Furnace di Laboraturium Pelapisan Logam Jurusan Teknik Mesin Universitas Negeri Surabaya selesai pada tanggal 4 Mei 2021.

Demikian surat keterangan ini dibuat untuk digunakan sebagaimana mestinya.

Surabaya, 04 Mei 2021

KaSubLab.

Pengujian Bahan & Pelapisan Logam




(Tri Hartutuk Ningsih, S.T.,M.T.)





