

LAMPIRAN A

KALIBRASI EFISIENSI DETEKTOR NaI(Tl)

Kalibrasi efisiensi dilakukan untuk mencari efisiensi deteksi suatu sistem spektrometer. Dalam penelitian ini dipakai efisiensi mutlak yang dihitung dengan persamaan:

$$\varepsilon(E\gamma) = \frac{\text{cps}}{\text{dps} \cdot Y(E\gamma)}$$

Kalibrasi spektrometer NaI(Tl) dilakukan pada kondisi kerja sebagai berikut :

Detektor	: NaI(Tl) (Quartz 12512/ 3A-DZ 393)
Tegangan	: 600 V Canberra 3002
Pre Amp	: 100 V Ortec 311
Amplifier	: Ortec 570
Coarse gain	: 200 X
Fine gain	: 2 μ s
Penganalisis	: MCA Ortec 7010
Accuspec	: Accuspec A ND PCAT A IO 3004 On board ADC
Jarak Detektor-Sumber	: 1 cm

Sumber	: Eu ¹⁵²
Aktivitas (A ₀)	: 10 μCi (8 Februari 1986) = 10 ⁻⁵ Ci x 3,7 . 10 ¹⁰ Bq/Ci = 3,7 . 10 ⁵ Bq
Umur Paro (T _{1/2})	: 13,1 tahun = 13,1 tahun x 365,5 hari/tahun = 4788,05 hari
Tanggal Kalibrasi	: 30 April 1996

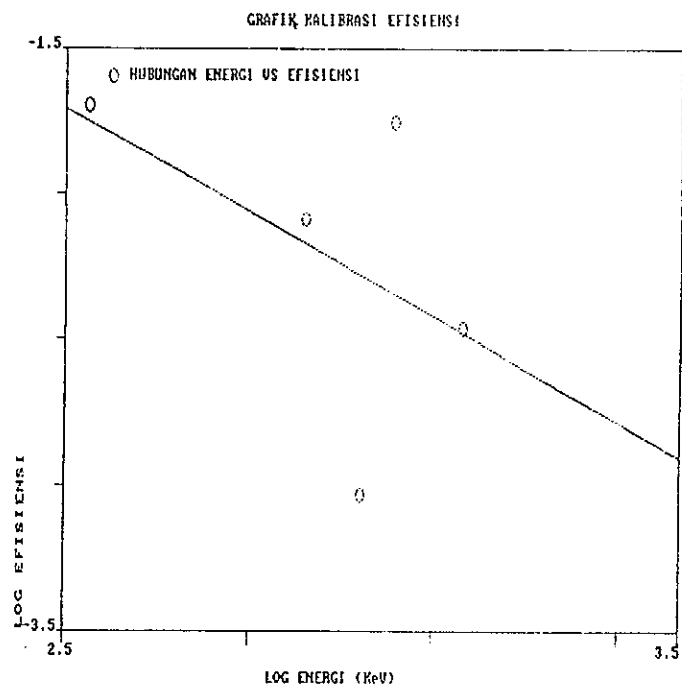
Dengan waktu tunda (8 Februari 1986 sampai 30 April 1996) 3737 hari didapatkan aktivitas sumber pada saat kalibrasi spektrometer NaI(Tl) sebesar :

$$\begin{aligned}
 \text{dps (30 April 1996)} &= A_0 \cdot e^{-\lambda t} \\
 &= A_0 \cdot e^{-\ln 2 \cdot t / T_{1/2}} \\
 &= A_0 \cdot 0,5^{t/T_{1/2}} \\
 &= 3,7 \cdot 10^5 (0,5)^{3737/4788,05} \\
 &= 2,1540 \times 10^5 \text{ dps}
 \end{aligned}$$

$$\begin{aligned}
 \varepsilon(E - \gamma) &= \frac{\text{cps}}{\text{dps} \cdot Y(E - \gamma)} \\
 &= \frac{1153}{2,1540 \times 10^5 \cdot 0,2640} \\
 &= 20,2759 \times 10^{-3}
 \end{aligned}$$

Tabel A.1 perhitungan efisiensi

E- γ (KeV)	Gamma Yield	cps	Efisiensi (10 ³)	Log E- γ	Log Efisiensi
344.28	0.2640	1153	20.2759	2.5369	-1.6980
778.90	0.1300	228	8.1423	2.8915	-2.0893
964.05	0.1448	29	0.9298	2.9841	-3.0316
1085.83	0.1014	385	17.6269	3.0358	-1.7538
1408.03	0.2070	152	3.4090	3.1486	-2.4674



Gambar A.1 Grafik kalibrasi efisiensi.

Dengan Regresi Linier diperoleh persamaan :

$$Y = 1,287 + (-1,197)X$$

dimana :

$$Y = \text{Log } s$$

$$X = \text{Log } E-\gamma$$

Untuk energi gamma 1368,6 KeV, maka diperoleh harga efisiensi sebesar : $3,41 \cdot 10^{-3}$.

LAMPIRAN B

DATA HASIL UJI KEKERASAN DAN UJI TARIK BAHAN Al-2024T3

Data Uji Kekerasan

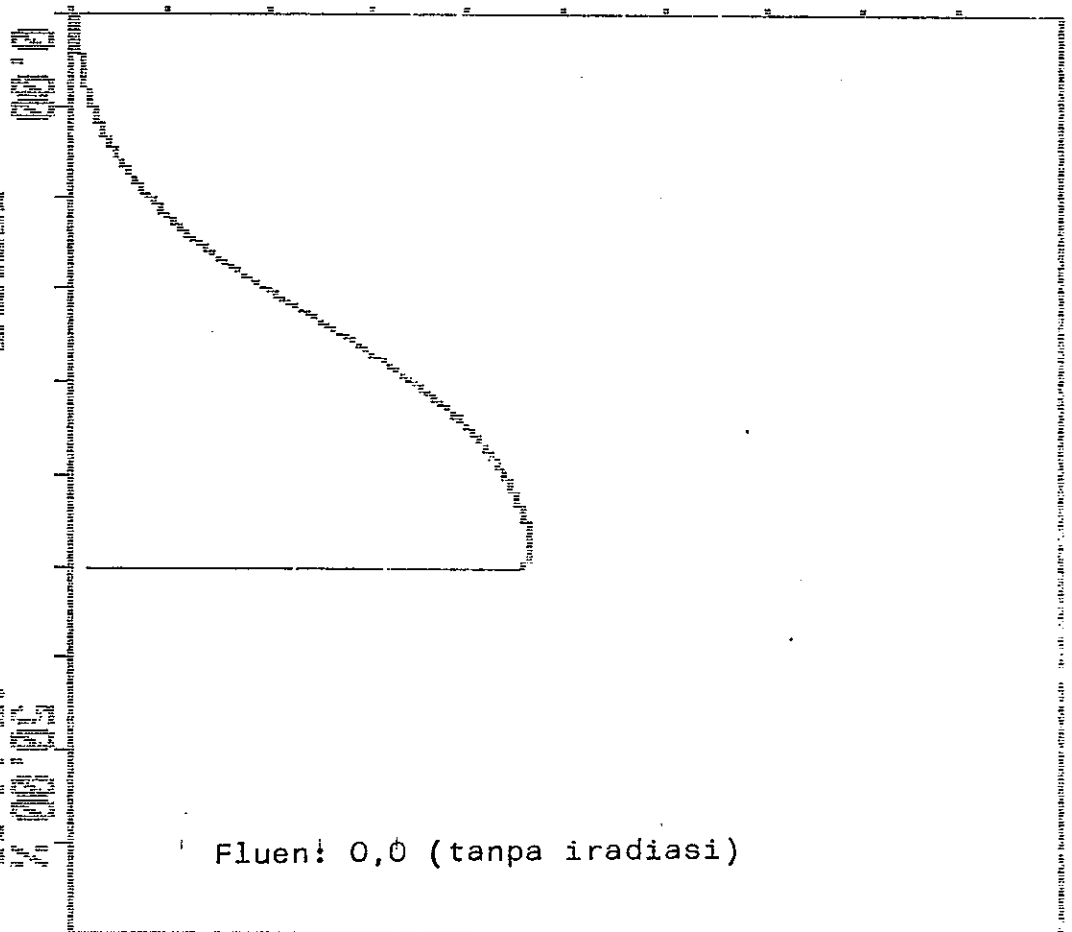
Tabel B.1 Data hasil uji kekerasan bahan Al-2024T3

No	Fluen (n/cm ²)	Kekerasan (KHN)		
		1	2	3
1	0.0	105.7	106.2	105.7
2	8.035×10^{09}	121.9	124.4	122.4
3	4.964×10^{10}	131.8	131.0	131.3
4	1.127×10^{12}	142.0	142.3	142.0
5	1.312×10^{12}	143.1	143.7	143.1
6	1.732×10^{12}	146.9	145.7	147.3
7	7.974×10^{12}	162.8	163.2	162.6
8	9.706×10^{12}	177.5	177.9	177.4
9	1.467×10^{13}	186.7	185.4	184.1

Data Uji Tarik

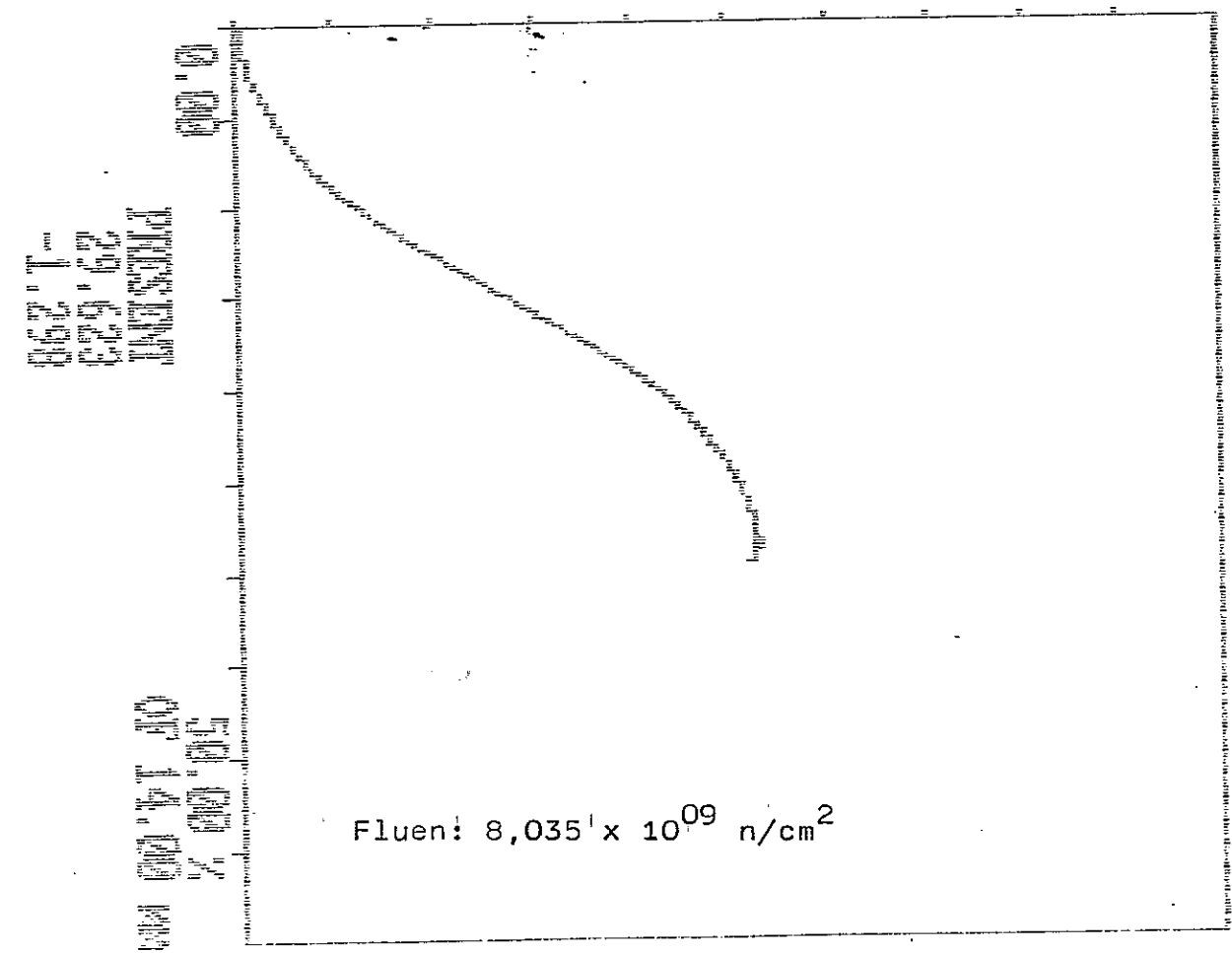
P1 DIRECTION TENSION
 P2 AUTOMATIC STOP
 P3 LINEAR UNITS MM
 P4 FORCE UNITS KG
 P5 AREA COMP ON
 P6 CYCLING OFF
 P7 TEST SPEED 2.540 MM/MIN
 P8 RETURN SPEED 100.000 MM/MIN
 P9 PRELOAD 0.200 KG
 P10 SETUP SCALAS CHP = 13608 KG
 P11 PRELOAD 444
 P12 TEST *
 P13 STOP *
 P14 CONTINUE *** STOP
 P15 RETURN *
 P16 JOG ***
 P17 ZERO POSITION COUNT
 P18 X-Y PLOT FROM MEMORY
 P19 Alt-Q TO QUIT PROGRAM
 P20 0.000

POSITION 4.2132
 0 PERK
 EXTENSION 28.620
 LOAD 46.633
 0 BREAK
 30.081
 45.335



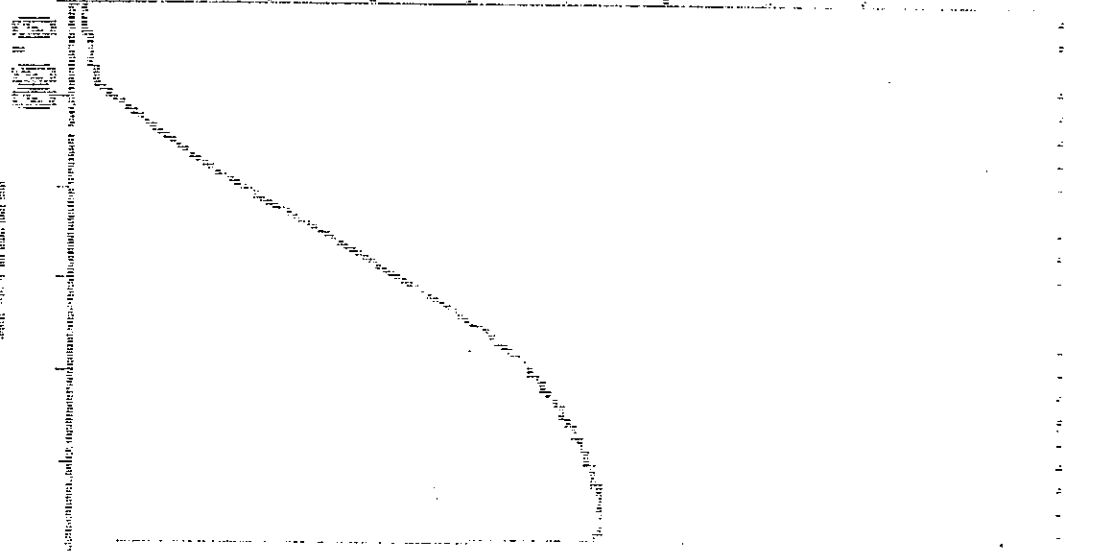
END OF 12.000 MM

14 DIRECTION TENSION
 13 AUTOMATIC STOP
 12 LINEAR UNITS MM
 11 FORCE UNITS KG
 10 HOLD COMP ON 8.000
 9 CYCLING OFF
 8 TEST SPEED 2.546 MM/MIN
 7 RETURN SPEED 100.000 MM/MIN
 6 PRELOAD 0.200 KG
 5 STRIP SCALES CAP = 13608 KG
 4 PRELOAD ***
 3 TEST ***
 2 STOP ***
 1 CONTINUE *** STOP
 0 RETURN ***
 105 ***
 2 ZERO POSITION COUNT
 1 X-Y PLT FROM MEMORY
 0 ATT-D TO QUIT PROGRAM



POSITION	4.1135
START	0.0000
STOP	28.617
TIME	33.749
START	0.0000
STOP	29.255
TIME	32.507

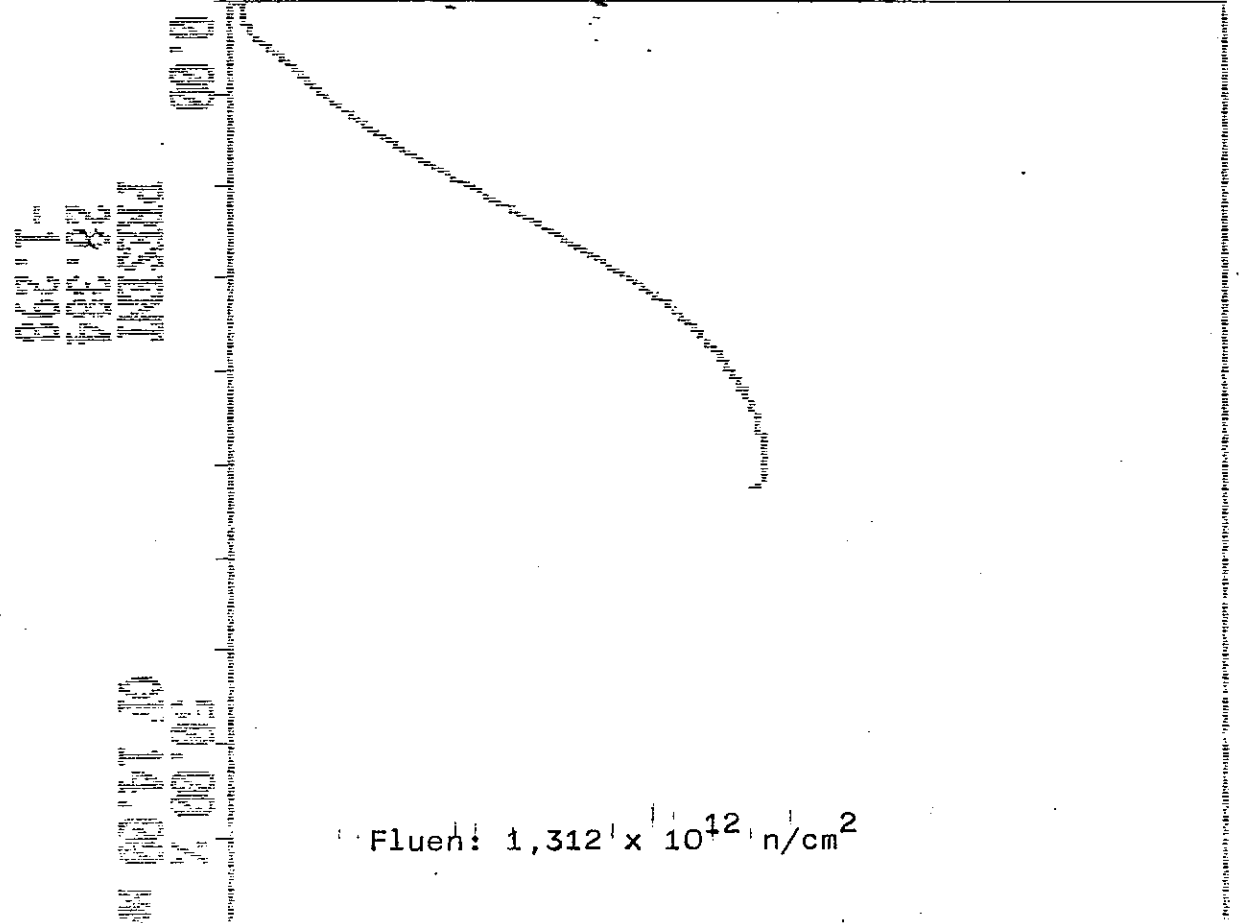
1 0.0000 0.0000
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 99 0.0000 0.0000
 100 0.0000 0.0000



POSITION	4.1135
START	0.0000
STOP	28.617
TIME	33.749
START	0.0000
STOP	29.255
TIME	32.507

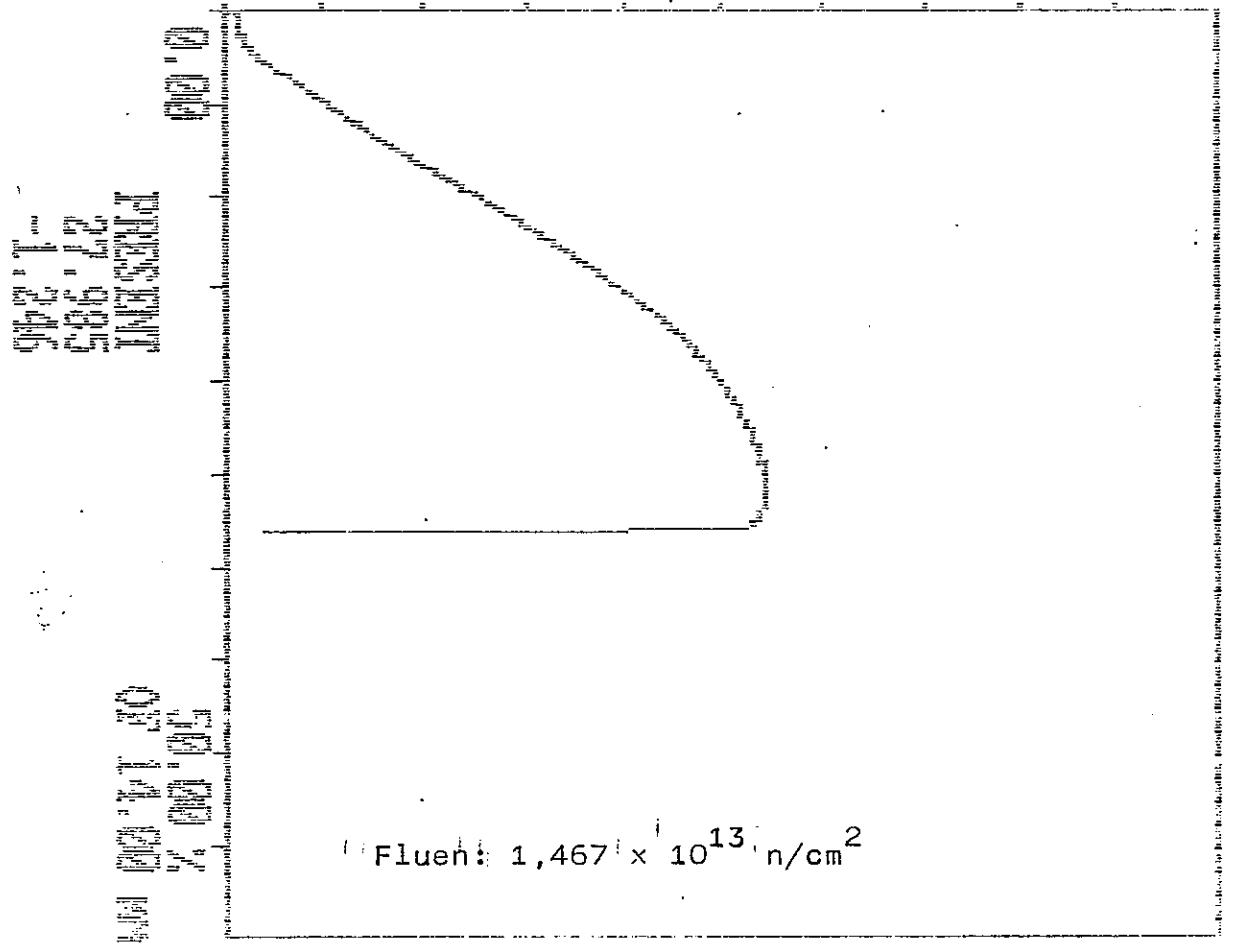
Fluence: $4,964 \times 10^{10}$ n/cm²

11 DIRECTION TENSION
 12 ALLOWANCE STOP
 13 LINEAR UNITS MM
 14 FORCE UNITS KG
 15 AREA COMP ON
 16 CYCLING OFF
 17 TEST SPEED 2.500 MM/MIN
 18 RETRAN SPEED 100.000 MM/MIN
 19 PRELOAD 0.200 KG
 20 STRIP GAUGES CAP = 10000 KG
 21 PRELOAD MKK
 22 TEST MKK
 23 STOP MKK
 24 CONTINUE MKK STOP
 25 RETURN MKK
 26 LOG MKK
 27 ZERO POSITION COUNT
 28 ZERO POINT MEMORY
 29 ATT-0 TO QUIT PROGRAM



POSITION 3.694
 @ PEAK
 EXTENSION 24.901
 LOAD 52.773
 @ BREAK 28.216
 @ BREAK 52.345
 @ BREAK 28.384
 @ BREAK 1.298
 @ 14.00 MM

01 REACTION POSITION 100.0
 02 AUTOMATIC STOP 0.000
 03 FLOW LINE 0.000
 04 FLOW LINE 0.000
 05 FLOW COMP 0.000
 06 FLOW COMP 0.000
 07 FLOW COMP 0.000
 08 FLOW COMP 0.000
 09 FLOW COMP 0.000
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LAMPIRAN C

CONTOH PERHITUNGAN FLUEN NEUTRON

$$F = \phi \times t_{ir}$$

dengan,

$$\begin{aligned} \phi &= \frac{C \times BA \times \ln 2}{m \times N_A \times a \times \sigma \times Y \times \epsilon \times T_{1/2} \left(1 - 0.5^{t_r/T_{1/2}}\right) 0.5^{t_d/T_{1/2}} \left(1 - 0.5^{t_c/T_{1/2}}\right)} \\ &= \frac{2524 \times 27 \times 0.693}{1.0029 \times (6.02 \times 10^{23}) \times 1 \times (1.16 \times 10^{-25}) \times 1 \times (3.41 \times 10^{-3})} \times \\ &\quad \frac{1}{(1 - 0.5^{7200/54072}) \times 0.5^{330/54072} \times (1 - 0.5^{300/54072})} \\ &= 1.116 \times 10^6 \text{ neutron/cm}^2 \cdot \text{dt} \end{aligned}$$

$$S_\phi = \sqrt{\left(\frac{\partial \phi}{\partial C} S_C\right)^2 + \left(\frac{\partial \phi}{\partial \sigma} S_\sigma\right)^2}$$

$$\frac{\partial \phi}{\partial C} = \frac{BA \times \ln 2}{m \times N_A \times a \times \sigma \times Y \times \epsilon \times T_{1/2} \left(1 - 0.5^{t_r/T_{1/2}}\right) 0.5^{t_d/T_{1/2}} \left(1 - 0.5^{t_c/T_{1/2}}\right)}$$

$$= \frac{27 \times 0.693}{1.0029 \times (6.02 \times 10^{23}) \times 1 \times (1.16 \times 10^{-25}) \times 1 \times (3.41 \times 10^{-3})} \times \frac{1}{(1 - 0.5^{7200/54072}) \times 0.5^{330/54072} \times (1 - 0.5^{300/54072})}$$

$$= 442.155$$

$$S_c = \sqrt{C}$$

$$= \sqrt{2524}$$

$$= 50.239$$

$$\frac{\partial \phi}{\partial \sigma} = \frac{C \times B4 \times \ln 2}{m \times N_A \times a \times \sigma^2 \times Y \times \epsilon \times T_{1/2} (1 - 0.5^{t/T_{1/2}}) 0.5^{t/T_{1/2}} (1 - 0.5^{t_c/T_{1/2}})}$$

$$= - \frac{2524 \times 27 \times 0.693}{1.0029 \times (6.02 \times 10^{23}) \times 1 \times (1.16 \times 10^{-25})^2 \times 1 \times (3.41 \times 10^{-3})} \times \frac{1}{(1 - 0.5^{7200/54072}) \times 0.5^{330/54072} \times (1 - 0.5^{300/54072})}$$

$$= -9.621 \times 10^{30}$$

$$S_\sigma = 3 \times 10^{-27} \text{ cm}^2$$

$$S_\phi = \sqrt{(442.155 \times 50.239)^2 + (-9.621 \times 10^{30} \times 3 \times 10^{-27})}$$

$$= 0.036 \times 10^6 \text{ neutron/cm}^2$$

$$F = \phi \times t_{ir}$$

$$= (1.116 \times 10^6) \text{ neutron/cm}^2 \cdot \text{dt} \times 7200 \text{ dt}$$

$$= 8.035 \times 10^9 \text{ neutron/cm}^2$$

$$S_F = \sqrt{\left(\frac{\partial F}{\partial \phi} S_\phi\right)^2 + \left(\frac{\partial F}{\partial t_{ir}} S_{t_{ir}}\right)^2}$$

$$\frac{\partial F}{\partial \phi} = t_{ir}$$

$$\frac{\partial F}{\partial t_{ir}} = \phi$$

$$S_F = ((7200 \times 0,036 \cdot 10^6)^2 + (1,116 \cdot 10^6 \times 0,05)^2)^{1/2}$$

$$= 0.259 \times 10^9 \text{ neutron/cm}^2$$

$$F = (8.035 \pm 0.259) 10^9 \text{ neutron/cm}^2$$