«بسمه تعالی» عنوان سری پنجم شکست

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$$\frac{da}{dN} = 3.68 \times 10^{-12} (\Delta K_I)^4$$

$K_{IC} = 80 MPa\sqrt{m}$ $\quad \sigma_{max} = 403 MPa$

$\Delta\sigma = 403 MPa$

$a_0 = 2mm$

$a_f = 10mm$ $\quad n = 4$

$R = 0$

$$\Rightarrow K_{IC} = f(a/w)\,\sigma_{max}\sqrt{\pi a_f}$$

$$\Rightarrow \frac{da}{dN} = 3.68 \times 10^{-12} \left(f(a/w)\,\Delta\sigma\sqrt{\pi a_f}\right)^4$$

$$\Rightarrow \int_{a_0}^{a_f} \frac{da}{a^2} = 3.68 \times 10^{-12} \times \left(f(a/w)\,\Delta\sigma\sqrt{\pi a_f}\right)^4 \int_0^{N_f} dN$$

$$\Rightarrow \frac{-1}{a}\Big|_{a_0}^{a_f} = 3.68 \times 10^{-12} \left(1.12 \times 403 \times 10^{6} \sqrt{\pi \times 10 \times 10^{-3}}\right)^4 \int_0^{N_f} dN$$

$$\Rightarrow a_0^{-1} - a_f^{-1} = 1.51 N_f \Rightarrow N_f = 278.3 \text{ cycl}$$

$$t = \frac{N_f}{f} = \frac{278.3}{0.02} = 13916 \text{ sec} = 3.87 \text{ hour}$$

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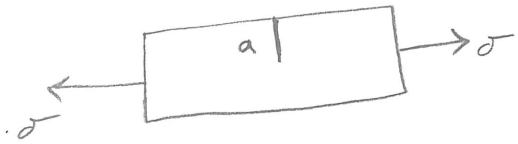
$$\frac{da}{dN} = 2 \times 10^{-8} (\Delta K_I)^{2.45} = 2 \times 10^{-8} \left(1.12\,\Delta\sigma\sqrt{\pi a}\right)^{2.45}$$

$$\int_{a_0}^{a_f} \frac{da}{a^{2.45}}\,da = 0.1257 \int_0^{N_f} dN = 4732.3 \Rightarrow \frac{a_0^{-1.45} - a_c^{-1.45}}{1.45} = 4732.3$$

$$\Rightarrow a_c = a_f = 7mm$$

$$K_{IC} = 1.12\,\Delta\sigma\sqrt{\pi a_c} = 1.12 \times 300\sqrt{\pi \times 7 \times 10^{-3}} = 50 MPa\sqrt{m}$$



a) $a = 7.86 \times 10^{-8}\ m$

$$\left.\frac{da}{dN}\right|_a = \frac{\Delta a}{\Delta N} = 7.86 \times 10^{-8}$$

$$\Delta K = E\sqrt{\frac{x}{6}} \qquad E\,(MPa) \qquad x\,(M\cdot m)$$

$$\Rightarrow \Delta K = 207 \times 10^{3}\sqrt{\frac{7.86 \times 10^{-8}}{6}} = 23.69\ MPa\sqrt{m}$$

$$\Rightarrow \Delta\sigma = \frac{\Delta K}{\sqrt{\pi a}} = \frac{23.69\ MPa\sqrt{m}}{\sqrt{\pi(0.01\ m)}} = 133.66\ MPa = \sigma_{max}$$

b) $\Delta K_b = \Delta\sigma\sqrt{\pi a} = (1.33.66)\sqrt{\pi(0.02)} = 33.50\ MPa\sqrt{m}$

$$x = 6\left(\frac{\Delta K}{E}\right) = 6\left(\frac{33.5\ MPa\sqrt{m}}{207 \times 10^{3}\ MPa}\right)^2 = 1.57 \times 10^{-7}\ m$$

$$\frac{da}{dN} = \frac{\Delta a}{\Delta N} = \frac{a}{\Delta N} = 1.57 \times 10^{-7}\ m/cycle$$

c) $\left.\frac{da}{dN}\right|_a = A(\Delta K_a)^n$

$\left.\frac{da}{dN}\right|_b = A(\Delta K_b)^n$

$$\Rightarrow n = \frac{\ln\left[\frac{\left.da/dN\right|_a}{\left.da/dN\right|_b}\right]}{\ln\left(\frac{\Delta K_a}{\Delta K_b}\right)} = \frac{\ln\left(\frac{7.86 \times 10^{-8}}{1.57 \times 10^{-7}}\right)}{\ln\left(\frac{23.69}{33.5}\right)} = 2$$

$$\Rightarrow A = \frac{\left(\frac{da}{dN}\right)_a}{(\Delta K)^n} = \frac{7.86 \times 10^{-8}}{(23.69)^2} = 1.4 \times 10^{-10} \Rightarrow \text{لذا}: \frac{da}{dN} = 1.4 \times 10^{-10}(\Delta K)^2$$

d) $K_{Ic} = \sigma_{max}\sqrt{\pi a_c} = (133.66)\sqrt{\pi \times (0.03)} = 41\ MPa\sqrt{m}$