Exam 2 NE591

80

1/ True stress strain the

4/4

stress is measured according ~~to~~ the current area of applied force and same for the ~~strain~~ so the elongation initial area ~~of~~ and measurement of elongation change through time meanwhile, in engineering stress strain the area is constant and it's the initial area prior to any applied force same for the ~~strain the elongation~~ it's the strain same prior to any load and

$\sigma_{engineering} = F/A_0$, $\sigma_{true} = \frac{F}{A}$

$\varepsilon_{engineering} = \frac{\Delta L}{L_0}$ $\varepsilon_{true} = \ln\left(\frac{l}{l_0}\right)$

8/8

2) elastic deformation the material deforms and after ~~remo~~ removing the applied force it return to it's original status

plastic Deformation is a permanent Deformation so the material won't be able to return to it's original shape after Deformation

3) 0D: Vacancies 4/4

3D: Voids

4) _ melting temperature 6/6

_ thermal conductivity

_ Grain Growth

5) ~~Grain~~ depending on the size 6/8 of the grains we have different ~~mech~~ mechanical properties

—not true

if we have bigger grains we have more density of dislocation inside the grain So more ductile material

directionally correct, but reasoning wrong

Smaller grains means less density of defect which means harder material and all of that depend on the processing etc...

6| Strain hardening after plastic deformation if we unload the sample it still has the permanent strain, So now our material becomes harder but less ductile what cases strain hardening is the evolution of the microstructure as our ~~[illegible]~~ grain will become thinner after strain ~~So now more plastic~~ but less ductile So it's harder

5/8

x

4/4

7) all fuel performance codes ~~must~~ must be able to predict:
The mechanical interaction
- between fuel and cladding gap?
- the temperature profile
- the stress and volumetric change

8) for fuel densification is burnup "fission" x 0/3

9) Temperature ~~rotation~~ can affect grain growth more temperature ~~more grain~~ ~~grai~~ faster grain growth

3/6

- what inhibits GG?

10)

11/16

a) Thin-wall

4/4

$$\sigma_\theta = \frac{pR}{\delta} \qquad \sigma_z = \frac{pR}{2\delta} \qquad \sigma_r = -\frac{1}{2}p$$

$\sigma_\theta = 135$ Mpa

$\sigma_z = \dfrac{\sigma_\theta}{2} = 67{,}5$ Mpa

$\sigma_r = -\dfrac{1}{2}p = -10$ Mpa

b) Thick walled assumpt.

$$\sigma_{rr}(r) = -p\,\frac{((R_o/r)^2 - 1)}{((R_o/R_i)^2 - 1}$$

$$\sigma_{\theta\theta} = p\,\frac{(R_o/r)^2 + 1}{(R_o/R_i)^2 - 1}$$

$$\sigma_{zz} = p\,\frac{1}{(R_o/R)^2 - 1}$$

at the midpoint

$r = 5,4 + \frac{0,8}{2} = 5,8\,mm$

5.4 is midpoint

~~$\sigma_{rr} = -20\,(5,4/5,8$~~

$\sigma_{rr} = -20\,\frac{(6.2/5.8)^2 - 1}{(6.2/5.2)^2 - 1}$ ✓

$\sigma_{rr} = -6,77\ Mpa$

6/8

$\sigma_{\theta\theta} = 20\,\left(\frac{(6.2/5.8)^2 + 1}{(6.2/5.2)^2 - 1}\right)$ ✓

$\sigma_{\theta\theta} = 101,64\ Mpa$ ✓

$\sigma_{33} = 20\,\frac{1}{(6.2/5.8)^2 - 1}$

$\sigma_{33} = 140,16\ Mpa$

C ⌋ :

1/4

$\sigma_{rr} = \overline{\sigma_{rr}}$

$\sigma_{33} = \overline{\sigma_{33}}$

$\sigma_{\theta\theta} = \overline{\sigma_{\theta\theta}}$

– where are they equal?

at what r?

$)^{8}$
-1

12/12

11)

$$\sigma_{\theta\theta}(\eta) = -\sigma^*(1 - 3\eta^2)$$

$$\sigma^* = \alpha \frac{E(T_0 - T_S)}{4(1-\gamma}$$

$$T_0 - T_S = \frac{LHR}{4\pi K}$$

$$T_0 - T_S = \frac{250}{4\pi \times 0{,}1} \qquad T_0 - T_S = 198{,}94\,K$$

$$\sigma^* = \alpha\, \frac{8{,}2 \times 10^{-6} \times 290 \times 198{,}94}{4(1-0{,}3)}$$

$$\sigma = 168{,}95\ Mpa$$

the maximum stree is when $\eta = 1$

so

$$\sigma_{\theta\theta} = -168{,}95 \times (-2)$$
$$= 337{,}91\ Mpa$$

10/16

12/

$\Delta \delta_{gap}' = \bar{R}_c \alpha_c (T_c - T_{ba})$
$- \bar{R}_f \alpha_f (T_f - T_{ref})$

~~$T_c = ?$ $T_f = ?$~~ T_c ? T_f ?

~~$T_{ic} - T_{clad} = LHR$~~

~~$T_0 - T_{fuel} = \frac{LHR}{4\pi}$~~

$T_{fuel} - T_{gap} = \frac{LHR}{2\pi R_f h_{gap}}$

$T_f - T_{gap} = \frac{325}{2\pi \times 0{,}5 \times \frac{0{,}1}{0{,}02}}$

$= 51{,}72$ ✓

$T_{fuel} = 51{,}72 + 450$

$= 501{,}72$ ✓

$$T_{gap} - T_{clad} = \frac{LHR\ t_{clad}}{2\pi R_{fuel} k_{clad}}$$

=

need $\overline{T}_f = \frac{T_0 - T_s}{2}$

~~T_{gap}~~ $T_{clad} = T_{ic}$

what is T_0 initially?

So $S_{gap} = \overline{R}_c \alpha_c (T_c - T)$
$- \overline{R}_f \alpha_f (T_f - T_{end})$

$S_{gap} = R_{cl}(0{,}5 + 0{,}02) \times 4{,}5\times10^{-6}$
$\times (450 - 300) - 0{,}5 \times 15\times10^{-6}$
$\times (501{,}72 - 300)$

$S_{gap} = 0{,}0011$

The new temperature

$$T_{fuel} - T_{gap} = \frac{LHR}{2\pi R_f h_{g}} = \frac{325}{2\pi \times 0{,}5\ \frac{0{,}01}{0{,}02 - 0{,}001}}$$

$= 18{,}88$

so $T_{fuel} = 498,88\,K$

- I didnt follow how you got to this number

13/1

7/8

$$\sigma_{\theta\theta}(r) = -\sigma^*(1-3r^2)$$ ✓

$$\sigma^* = \frac{\alpha E(T_0 - T_S)}{4(1-v)}$$ ✓

$$T_0 - T_S = \frac{LHR}{4\pi \times k_6} = \frac{200}{4\pi \times 0{,}05}$$

$$T_0 - T_S = 636{,}61\ K$$

- calculator error?
- factor of 2

~~$\sigma^* = \sigma^* = 10{,}5 \times 10^{-6} \times 210 \times 10^{3}$~~

$$\sigma^* = \frac{10{,}5 \times 10^{-6} \times 210 \times 10^{3} \times 636{,}16}{4 \times 0{,}75}$$

$$\sigma^* = 467{,}57\ Mpa$$

$\Delta T = 318\ K$

1

$$-\sigma_{Fr}/\sigma^* = 1 - 3n^2$$

$$3n^2 = 1 + \sigma_{Fr}/\sigma^*$$

$$n^2 = \sqrt{\frac{1 + \sigma_{Fr}/\sigma^*}{3}}$$

$$n = \sqrt{\frac{1 + 120/467{,}57}{3}}$$

$$n = 0{,}647$$

- wrong answer, right process