44

ID: 200441141

P.1

Que: 1

12/12

Given that, The boundary conditions are, $T'(x_0) = 0$

$x_0 = 0$

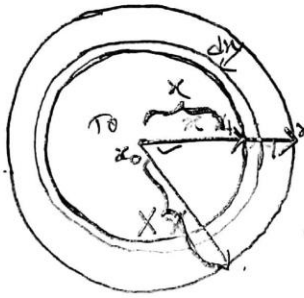
$x_1 = X$

$T(x_1) = T_1$

Now, Solving the temperature profile with boundary condition we can write,

$$\frac{d}{dx_0}\left(xk\frac{dT}{dx}\right) = -Qx \quad \checkmark$$

$$\therefore xk\frac{dT}{dx} = \frac{-Qx^2}{2} + C_1$$ [differentiating them with r.t. x]



Or, $0 = \frac{-Q \cdot 0^2}{2} + C_1$ ✓

Now, $\frac{dT}{dx} = -\frac{Qx}{2k}$

Or, $T(x) = -\frac{Qx^2}{4k} + C_2$ —①.

Or, $C_2 = \frac{QX^2}{4k} + T_1$ ✓

putting the value of C_2 in eq① we can get,

$$T(x) = \frac{-Qx^2}{4k} + \frac{QX^2}{4k} + T_1 \quad \checkmark$$

Or, $T(x) = \frac{Q(X^2 - x^2)}{4k} + T_1$ ✓

Or, $T(x) - T_1 = \frac{Q(X^2 - x^2)}{4k}$

Or, $T_0 - T_1 = \frac{Q(X^2 - x^2)}{4k}$

Or, $T_0 - T_1 = \frac{QX^2}{4k}$ [$\because x = x_0 = 0$]

Assumptions:

The assumptions that are made to get to this equations are:

(i) Steady state ✓

(ii) Axisymmetric ✓

(iii) Constant in z ✓

(iv) Constant thermal conductivity. ✓

Q82

8/16

Given that, Cooling $k = 0.015$ w/cm-k

cladding, $k = 0.15$ w/cm-k.

Gap $k = 0.004$ w/cm-k.

fuel $k = 0.05$ w/cm-k.

$T_s = 600K$.

$Q = 250$ w/cm^3

$R_F = 0.6$ cm

$t_g = 0.005$ cm

$t_{clad} = 0.05$ cm

$t_{coat} = 0.01$ cm

$T_{co} = 600K$.

∴ Centerline temperature without coating,

$$T_o = \frac{QR^2}{4K} + T_s.$$

= missed gap and cladding ΔT

$$= \frac{250 \text{ w/cm}^3 \times (0.6\text{cm})^2}{4 \times 0.05 \text{ w/cm-k}} + 600K$$

$$= 1050 K.$$

Centerline temperature with coating,

$$T_{cl} = \frac{LHR \, t_{clad}}{2\pi R_F k_{clad}} + T_{co}.$$

$$= \frac{LHR}{2\pi R_F} k_{gap} \frac{t_{clad}}{k_{clad}} + T_{co}. \quad \left[\because \frac{LHR}{2\pi R_F} = k_{gap}\right]$$

$$= 0.004 \text{ w/cm-k} \times (0.05\text{cm}/0.15 \text{ w/cm-k}) + 600K$$

$= 600.001\ K$.

Now, fuel centerline temperature with coating $= T_{CL} + T_{CO}$

$= 600.001 + 600\ K$

$= 1200.001\ K$

Also:

- need to get ΔT_{clad}, ΔT_{gap}, ΔT_{coat}
- then can do ΔT over fuel

#3 0/14

#4 0/12

#5 0/12

Q.6 4/4

Fertile: In fertile isotopes can convert into fissile isotopes. ✓

Fissile: In that isotopes the atoms can undergo fission reactions. ✓

Fissionable: In that nuclide is capable of undergoing fission after capturing high energy neutrons or low energy neutrons. ✓

Q.7

Reasons: 3/4

(i) During thermal cycling, pure uranium dramatically swells. ✓

(ii) It has both anisotropic thermal expansion and anisotropic irradiation growth. α-U, not γ-U

Q.8

Smear density: 2/4

The percentage of actual fuel weight contained in the volume enclosed by a unit

p.4

Length of cladding relative to the weight which could be contained if the same volume were occupied by 100% dense fuel. ✓

Necessary because:

Because of →

⇒ It provides information on the number and shape of the cells. ✗ - swelling + fission gas release

Q: 9

⇒ Enrich U because it needs to have a higher concentration rather than the U exists in nature. ✓

6/8

⇒ UF_6 ✓

⇒ Centrifugal works by → ✓

rotating at rapid speed

↓

separating substances using centre force

↓

then work as final work

- why does this enrich?

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P.S

Q.10 — 2/6

Method → Euler method
→ Finite difference method
→ Taylor series method.

finite volume
finite element

Q.11 — 2/8

- no good/bad included here

~~Be~~ Departure from nucleate boiling and critical heating flux because of increase the heat transfer due to mixing and turbulation near to the heated surface.

- didn't really get here

Q.12 — 5/5

Layer → Light bridge → ~~Fra~~ fuel kernel ✓
→ Kairos (yes) → Buffer. ✓
→ Ara Ba / LANL. → IPyC ✓
→ SiC ✓
→ OPyC. ✓

~~Ex: UO2~~

Ex: UC.