> Questions
>
> a) The positions of grid spacers indicated in figure 2.5.2 don't agree with
> the positions given in table 3.2.6
>
A: Figure 2.5.2 shows that the thermocouples positions. It shows that the thermocouples were at the section where 6 mm upstream from the bottom face of the spacer.

> b) Geometric parameters of heater (Nichrome coil) are unknown, e.g.
> thickness.
>
A: As for the dimensions of the heater rod, we have already had a data disclosing process with the fuel bender. Inner diameter of heater rod and gaps were supposed to be provided. But, all data disclosed by them is that shown in Table 3.3.1. Gaps between heater, insulator and cladding could be assumed zero (contact). The original geometry of the heater (Nichrome) is spiral coil. We may treat the geometry as a rod. This treatment does not affect the steady-state calculation. For the transient, a thermal time constant may affect the results. Therefore, addition to the attached geometrical data, a thermal time constant of the simulated heater rod is provided for reference, that is, about 5 seconds.

> c) Equations for properties need to be checked, at least those for:
>
> - thermal conductivity of BN;
> - density of Inconel 600
> - specific heat of Inconel 600.

A: The properties were based on the MATPRO model used in TRAC code (Ref.8). The equations have been checked based on Ref. 8. Some type mistakes were found and which were collected by red character as follows;

Property of Nichrome

We assume that Nichrome coils have similar properties with that of Constantan.

(1) Density

A constant value of 8393.4 kg/m^3 is used. (Correct)

(2) Specific Heat

The specific heat is $c_p = 110\ T_f{}^{0.2075}$, (Correct)

where c_p is the specific heat (J/ kg·K) and T_f is the temperature (F).

(3) Thermal Conductivity

The thermal conductivity is $k = 29.18 + 2.683 \times 10^{-3} (T_f - 100)$, (Correct)

where k is the thermal conductivity (W/m·K) and T_f is the temperature (F).

Property of Boron Nitride

(1) Density

A constant value of 2002 kg/m^3 is used. (Correct)

(2) Specific Heat

The specific heat is

$c_p = 760.59 + 1.7955\ T_f - 8.6704 \times 10^{-4}\ T_f^2 + $ ~~1.7955~~ $1.5896 \times 10^{-7}\ T_f^3$

where c_p is the specific heat (J/ kg·K) and T_f is the temperature (F).

(3) Thermal Conductivity

The boron-nitride thermal-conductivity calculation, based on a conversion to SI units of a curve fit is $k = 25.27 - 1.365 \times$ ~~10.3~~ $10^{-3} T_f$,

where k is the thermal conductivity (W/m·K) and T_f is the temperature (F).

Property of Inconel 600

(1) Density

The density is

$$\rho = 16.01846 \times (5.261008 \times 10^2 - 1.345453 \times 10^{-2} T_f - 1.194357 \times 10^{-7}\ T_f^2),$$

where ρ is the density (kg/m^3) and T_f is the temperature (F).

(2) Specific Heat

The specific heat is

$c_p = 4186.8 \times (0.1014 + 4.378952 \times 10^{-5} T_f - 2.046138 \times 10^{-8} T_f^2 +$ ~~1.7955×10^{-7}~~ $3.418111 \times 10^{-11}\ T_f^3 - 2.060318 \times 10^{-13}\ T_f^4 + 3.682836 \times 10^{-16} T_f^5 - 2.458648 \times 10^{-19}\ T_f^6 + 5.597571 \times 10^{-23}\ T_f^7)$,

where c_p is the specific heat (J/ kg·K) and T_f is the temperature (F).

(3) Thermal Conductivity

The thermal conductivity is

$k = 1.729577 \times (8.011332 + 4.643719 \times 10^{-3} T_f + 1.872857 \times 10^{-6}\ T_f^2 - 3.914\ 512 \times 10^{-9}\ T_f^3 + 3.475513 \times 10^{-12}\ T_f^4 - 9.936696 \times 10^{-16} T_f^5)$, (Correct)

where k is the thermal conductivity (W/m·K) and T_f is the temperature (F).

>
> d) According to the grid spacers (figure 3.5.1), the rod arrangement is not
> homogenous. This can also be recognized in figure 3.5.6. Is this true?
A: Because it's not a design drawing but a caricature, some disparity from the symmetry could occur. It shall be homogenous.

> e) The dimensions given in figure 3.5.3 need to be checked. According to
> this figure, the rod diameter is about 8.3 mm, not 12.3 mm.
>
> f) The dimensions given in figure 3.5.13 need to be checked. The
> pitch should be 16.2 mm, not 15.5 mm. The rods are arranged also not
> homogenously. According to this figure, the rod diameter is smaller than
> 11 mm, not 12.3 mm
A: Refer the description on this issue written in from the last sentence in page 34 to several sentences in page 35.

> g) Some questions related to water rod
>
> - Figure 3.5.17: the geometric parameters specifying the water tube
> are not given
A: That is given in Table 3.2.7 and 3.2.8.

> - Does water be flowing through the water tube (water rod)? Or the
> water tube is filled with stagnant water?
A: Neither nor. In the test, water rod was simulated by non heated rod with no flow inside it.

> - In case with flowing water, what are the flow parameters, e.g.
> mass flow rate, inlet temperature?

> h) Is there any information about the heat loss during the test?
A: Unfortunately, no information on the heat loss was found in the available literature. As once discussed on this issue in BFBT-1, an adiabatic condition is suggested in the benchmark.

Answered by

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