# Tutorial 6: Heat Exchanger Modeling

# Problem Description:

A counter-current straight vertical shell and tube heat exchanger (without baffles) with liquid sodium on both shell and tube sides is considered. On the shell side, sodium enters at 544 °C with a mass flow rate of 1644 kg/s from top to bottom. On the tube side, sodium enters at a temperature of 355 °C with a mass flow rate of 1461 kg/s from bottom to top. The active heat transfer length is 7.5 m. The tube inner and outer diameters are 17.4 mm and 19 mm, respectively. There are 3600 tubes in the heat exchanger. The shell's inner diameter is 1.831 m. The heat transfer coefficient correlations given by equations (26) and (27) shall be used to estimate the heat transfer on the tube side and shell side, respectively. The total heat transfer rate in the heat exchanger must be estimated. The material properties for sodium and tube material shall be used as given in Table 12. (As sodium properties are not available in the CoolProp database, a user-defined fluid is created and used.)

|  |  |  |
| --- | --- | --- |
|  |  | (26) |
|  |  | (27) |

(Note: This problem approximates the Sodium cooled Fast Reactor (SFR) Intermediate Heat Exchanger (IHX) conditions)

Table 12: Material Properties for Problem 3.4.1

|  |  |  |
| --- | --- | --- |
|  | Property | Value |
| Liquid Sodium | Specific Heat | 1267 Jkg-1K-1 |
| Density | 860 kg/m3 |
| Viscosity | 3.75E-4 Pas |
| Thermal conductivity | 70 Wm-1K-1 |
| Tube | Thermal conductivity | 20 Wm-1K-1 |

# Results

The heat transfer rate is estimated as 308 MW which is close to the value reported in [19] (312.5 MW, deviation ~1 % only). Thus, the PINET code can accurately simulate conjugate heat transfer problems.