**Molten Salt TES Java Script Documentation**

This document describes Salt\_Tanks\_Main.java, which models the temperature and volume of the hot and cold tanks over time for different types of molten salt. The script works in tandem with XYPlot.java, which plots the created data sets that model tank properties.

* 1. **Description of Parameters in Salt\_Tanks\_Main.java**
     1. Set Parameters:
  + **TANK\_RADIUS**: hot and cold tank radius (m)
  + **TANK\_HEIGHT**: hot and cold tank height (m)
  + **STARTING\_HOT\_TANK\_VOL\_FRACT**: the fraction of the total fluid that is initially in the hot tank
  + **P\_IN**: rate at which thermal power is transferred in when charging (J/s)
  + **P\_OUT**: rate at which thermal power is transferred out when discharging (J/s)
  + **T\_HL**: array of target hot tank temperatures (K)
  + **T\_CL**: array of target cold tank temperatures (K)
  + **T\_inf**: the ambient temperature outside the tank (K)
  + **hx\_cf**: heat transfer coefficient for natural circulation connective heat transfer to the environment (W/m2K)
  + **salt**: type of molten salt (Solar Salt, Hitec XL, Glauber)
  + **c\_p**: specific heat of molten salt (J/kg-K)
  + **rho**: density of molten salt (kg/m3)
  + **N\_EVENTS**: number of charge, discharge, or constant periods
  + **event**: array of event numbers corresponding to charge, discharge, or constant periods
  + **endt\_event**: array of the end times of all events (seconds)
  + **dt**: time step (seconds)
  + **yaxis1**: bounds of the y axis for hot tank temperature plot
  + **yaxis2**: bounds of the y axis for the cold tank temperature plot
  + **yaxis3**: bounds of the y axis for the hot tank volume plot
  + **yaxis4**: bounds of the y axis for the cold tank temperature plot
    1. Calculated Parameters:
  + **tsteps\_per\_event**: array of the number of time steps in each event
    - For the first event, tsteps\_per\_event = endt\_event / dt
    - For all subsequent events, tsteps\_per\_event = the difference in current and previous endt\_event / dt
  + **TANK\_TOTVOL**: total volume of the tank (m3)
    - TANK\_TOTVOL = 𝜋(TANK\_RADIUS)2(TANK\_HEIGHT)
  + **TANK\_SIDESA**: area of the sides of the tank (m2)
    - TANK\_SIDESA = 2𝜋(TANK\_RADIUS) (TANK\_HEIGHT)
  + **Th**: array of the temperature of the hot tank over time
    - Refer to section 1.2 for formula
  + **Tc**: array of the temperature of the cold tank over time
    - Refer to section 1.2 for formula
  + **Vc**: array of volumes of the cold tank over time
    - Refer to section 1.2 for formula
  + **Vh**: array of volumes of the hot tank over time
    - Refer to section 1.2 for formula
  + **mh**: initial mass of the hot tank (kg)
    - mh = TANK\_TOTVOL\*rho\*STARTING\_HOT\_TANK\_VOL\_FRAC
  + **mc**: initial mass of the cold tank (kg)
    - mc = TANK\_TOTVOL\*rho\*(1-STARTING\_HOT\_TANK\_VOL\_FRAC)
  + **Th1-Th9**: array of the temperature of the hot tank over time for a given temperature range and heat transfer coefficient
  + **Tc1-Tc9**: array of the temperature of the cold tank over time for a given temperature range and heat transfer coefficient
  + **Vh1-Vh9**: array of the volume of the hot tank over time for a given temperature range and heat transfer coefficient
  + **Vc1-Vc9**: array of the volume of the cold tank over time for a given temperature range and heat transfer coefficient
  1. **Script Summary**
* Lines 40-120 contain the inputs for the script
* The sensitivity parameters are the following:
  + Hot and cold tank target temperature range (T\_HL and T\_CL)
    - Set in lines 56-61
  + Heat transfer coefficient (hx\_cf)
    - Set in line 64
  + Salt type (c\_p and rho)
    - Set in lines 69-90 based on input salt type
* Nine combinations of these parameters are used to perform the sensitivity analysis (9 trials will be run)
* The number of events (charge, constant, or discharge cycle) is set in line 93
* The event array is initiated with values of 0, 1 or 2 to correspond to a charge, constant, or discharge cycle in lines 99-106
* The end time of each event (in seconds) is set in lines 113-120
* The time step is set in line 122
* Total tank volume and area of the tank sides are calculated in lines 128 and 129
* The number of time steps in the first event is calculated in line 134
* The total number of time steps in all events is calculated with the loop in lines 139-144
* Six 1D arrays (Th, Tc, etc.) are created in lines 155-160 for the temperature, volume, and mass of the hot and cold tanks
* Four temporary 2D arrays (Th\_temp, Tc\_temp, etc.) are created in lines 166-169. These arrays will store all the result for Th, Tc, Vh, and Vc for the nine sensitivity trials.
* The loops starting in lines 176 and 177 were created to iterate though the different sensitivity inputs
  + ‘h’ iterates through the three heat transfer coefficients
  + ‘g’ iterates through the three temperature ranges
* Initial assignments and calculations for Th, Tc, Vh, and Vc at time step 0 are made in lines 181-186
* Based on the event type (charge, constant, or discharge), Th, Tc, Vh, and Vc values are calculated incrementally at various time steps in the event (lines 194-235). All values are stored in the Th, Tc, Vh, and Vc 1D arrays.
* Th, Tc, Vh, and Vc values are based off the following formulas:
* Once all temperature and volumes are calculated for a given sensitivity trial, the results are stored in the temporary 2D arrays (lines 239-245)
* In lines 254-297, 36 1D arrays (Th1-9, Tc1-9, etc.) are created to hold the Th, Tc, Vh, and Vc results of each sensitivity trail
* Assignments from the temporary 2D arrays are made to the 36 1D arrays in lines 300-346
* Y-axis bounds are defined for Th, Tc, Vh, and Vc plots in lines 255-358
* The XYPlot.MakePlot function is called in line 362, 365 ,368, and 371 for Th, Tc, Vh, and Vc, respectively. The 36 arrays are passed to XYPlot.java to be plotted (9 arrays for each function call). Axis titles and y-axis bounds are also passed.
* Lines 377-400 create a csv file containing data for the high and low sensitivity trials of Th, Tc, Vh, and Vc. This section should be commented out unless csv data is needed.