Temperature Flat Source Solution @model

Motivation

The Temperature Flat Source Solution @model is one of the fundamental solutions of temperature diffusion equations modelling the temperature conduction in linear direction (see **Fig. 1**).

This temperature profile is very common in subsurface studies, particularly in modelling the temperature above and below the lateral reservoir flow with a temperature T_f .

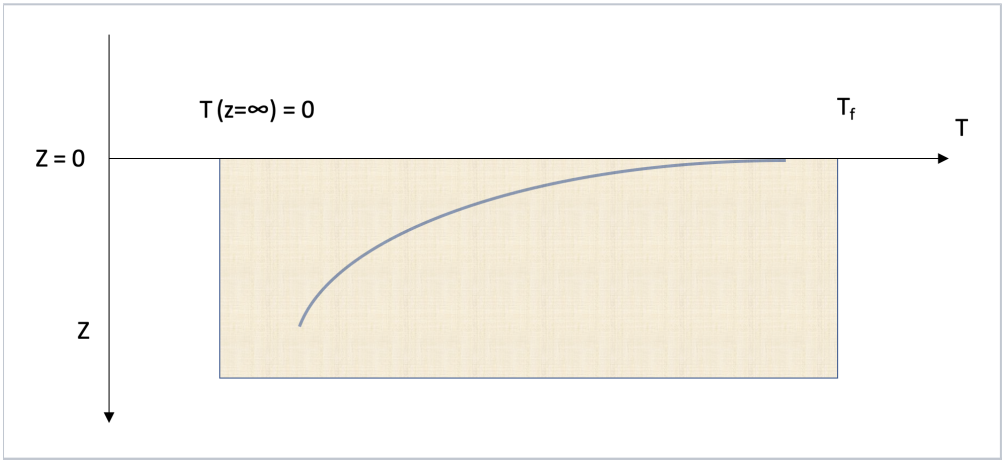

Fig. 1. Sample Temperature Flat Source Solution

Outputs

$T(t,z)$	Temperature distribution

Inputs

t	Time lapse after the temperature step from $T(z=0)=0$ up to $T(z=0)=T_f$
z	Spatial coordinate along the transversal direction to constant temperature $T(z)=T_f$ plane $z=0$
T_f	Boundary temperature at $z=0$
a	Thermal diffusivity of the surroundings

Equations

Driving equation	Initial conditions	Boundary conditions
(1) $\frac{\partial T}{\partial t} = a^2 \Delta T = a^2 \frac{\partial^2 T}{\partial z^2}$	(2) $T(t = 0, z) = 0$	(3) $T(t, z = 0) = T_f = \text{const}$ (4) $T(t, z \to \infty) = 0$

Solution

(5) $$T(t, z) = T_f \cdot \left[1 - \operatorname{erf}\left(\frac{z}{\sqrt{4at}}\right)\right] = T_f \cdot \left[1 - \frac{2}{\sqrt{\pi}} \int_0^{z/\sqrt{4at}} e^{-\xi^2} d\xi\right]$$

where

$\operatorname{erf}(x)$	Error function

See also

Physics / Fluid Dynamics / Linear Fluid Flow