Formula Thermal Process Safety

Adiabatic temperature rise

$$\Delta T_{ad} = \frac{Q'}{c'_P}$$

ΔT_{ad} : *adiabatic temperature rise* $[K]$

Q' *specific reaction energy* $[kJ\ kg^{-1}]$

c'_P *specific heat capacity* $[kJ\ kg^{-1} K^{-1}]$

Time to maximum rate

$$TMR_{ad} = \frac{c'_P \cdot R \cdot T_0^{\ 2}}{q'_0 \cdot E}$$

TMR_{ad} *Time to Maximum Rate under adiabatic conditions* $[s]$

c'_P *specific heat capacity* $[J\ kg^{-1} K^{-1}]$

R *ideal gas constant* $[J\ mol^{-1} K^{-1}]$

T_0 *initial temperature* $[K]$

q'_0 *specific heat release rate at* T_0 $[W\ kg^{-1}]$

E *activation energy* $[J\ mol^{-1}]$

Extrapolation of heat release rate

$$q'_{(T)} = q'_{ref} \cdot \exp\left[\frac{E}{R}\left(\frac{1}{T_{ref}} - \frac{1}{T}\right)\right]$$

q'_{ref} *specific heat release rate at* T_{ref} $[W\ kg^{-1}]$

$q'_{(T)}$ *specific heat release rate at* T $[W\ kg^{-1}]$

R *ideal gas constant* $[J\ mol^{-1} K^{-1}]$

T *temperature* $[K]$

T_{ref} *reference temperature* $[K]$

E *activation energy* $[J\ mol^{-1}]$

Activation energy from two points

$$E = \frac{R \cdot \ln\left(\frac{q'_1}{q'_2}\right)}{\frac{1}{T_2} - \frac{1}{T_1}}$$

q'_1 *specific heat release rate at* T_1 $[W\ kg^{-1}]$

q'_2 *specific heat release rate at* T_2 $[W\ kg^{-1}]$

R *ideal gas constant* $[J\ mol^{-1} K^{-1}]$

T_1 *temperature* $[K]$

T_2 *temperature* $[K]$

E *activation energy* $[J\ mol^{-1}]$

Vapour mass flow rate

$$\dot{m}_v = \frac{q' \cdot M_r}{\Delta H_v}$$

$\dot{m}_v$ *Vapour mass flow rate* $[kg\ s^{-1}]$

q' *heat release rate* $[W\ kg^{-1}]$

M_r *reaction mass* $[kg]$

ΔH_v *latent heat of evaporation* $[J\ kg^{-1}]$

Amount of vapor (mass)

$$M_v = \frac{Q' \cdot M_r}{\Delta H_v}$$

Q' *Reaction energy* $[J\ kg^{-1}]$

M_r *reaction mass* $[kg]$

ΔH_v *latent heat of evaporation* $[J\ kg^{-1}]$