Module 2: Exercises: Consequences

Problem 1

	Heat of reaction 100 kJ/kg reaction mass	Heat of decomposition 2000 kJ/kg reaction mass
Adiabatic temperature rise c'p= 2 kJ/(kg·K)	$\Delta Tad = \frac{100\ kJ/kg}{2\ \frac{kJ}{kg \cdot K}} = 50K$	$\Delta Tad = 1000K$
Mass of methanol to be evaporated per kg of reaction mass Heat of evaporation of methanol Q'_{vap} = 1100 kJ/kg MeOH	$m_{vap} = \frac{100\ \frac{kJ}{kg}}{1100\ \frac{kJ}{kg\ MeOH}}$ $= 0.1\ \frac{kg\ MeOH}{kg}$	$m_{vap} = 1.8\ \frac{kg\ MeOH}{kg}$ *This is not possible. There can't be more than 1 kg MeOH in 1 kg reaction mass*
Potential mechanic energy: height per kg of reaction mass	$h = \frac{100'000\ \frac{J}{kg}}{1kg\ \cdot 9.81\ \frac{m}{s^2}}$ $= 10'000m$	$h = 200\ km$
Kinetic energy: achieved speed per kg of reaction mass	$v = \sqrt{\frac{2 \cdot 100'000\ \frac{J}{kg}}{1kg}}$ $= 447\ m/s$ *This is 1.5 times the speed of sound!*	$v = 2000\ m/s$ *This is more than 6 times the speed of sound!*

A heat of reaction of 100 kJ/kg is rather low.
A heat of decomposition of 2000 kJ/kg is already very high

An energy also has units of 1 J = 1 N·m = 1 W·s = 1 kg·m^2·s^{-2}

The result show that conversion of reaction energy into more common forms of energy leads to impressive numbers.