Today, we will:

- Discuss the HERP index (**Section 1.2, Table 1.6**)
- Do some example problems
- Review some fundamentals (**Section 1.5**)
- Do Candy Questions for Candy Friday

HERP = Human Exposure Dose / Rodent Potency Dose

= an index for measuring & comparing the carcinogenity of substances

(likely to cause cancer)

Define TD_{50} = Daily dose rate $\left(\frac{\text{mg chemical}}{\text{kg of body weight}}\right)$

for which 50% of the rodents develop cancer

$$\text{HERP }(\%) = \frac{\text{daily human dose (over a lifetime)} \left(\frac{mg}{kg}\right)}{\text{daily rodent dose (over a lifetime)} \left(\frac{mg}{kg}\right)} \times 100\%$$

If HERP = 100%, a person has a 50% chance of getting cancer

Assuming that rodent data scale properly to humans!

Eg. HERP = 0.6% → means a person has a 0.3% chance of getting cancer

HERP indices are useful for comparisons → See Table 1.6 ★

LARGER HERP mean GREATER POTENTIAL RISK

Example

Given:

- Bacon has some carcinogens
- Diet soda with saccharin has some carcinogens

To do: Using HERP data, calculate how many 100 gram servings of bacon per day (every day of your life) you would need to eat to have the same cancer risk as drinking one 12-oz. diet cola with saccharin (every day of your life).

Solution: Table 1.6 → Define N_b = # servings of bacon per day

N_c = # cans of soda per day

Equate the risks:

$$\text{Bacon risk} = N_b \left(\frac{\text{mass}}{\text{serving}}\right)\left(\frac{HERP_b}{\text{mass}}\right) = \text{Soda risk} = N_c \left(\frac{HERP_s}{\text{can}}\right)$$

Solve for N_b

$$N_b = \frac{N_c\left(\frac{HERP_s}{\text{can}}\right)}{\left(\frac{HERP_b}{\text{mass}}\right)\left(\frac{\text{mass}}{\text{serving}}\right)} = \frac{(1 \text{ can})\left(\frac{0.06\,\%}{\text{can}}\right)}{\left(\frac{0.009\,\%}{100\text{ g}}\right)\left(\frac{100\text{ g}}{\text{serving}}\right)}$$

N_b = 6.67 servings

Ans: **7 servings** (1 sig. digit)

Read Sec 1.3 legal issues

Sec. 1.4 air pollution control strategies

Sec. 1.5 FUNDAMENTALS

Quick review & notation:

M = molecular weight = mass per mol of a substance

One mol = 6.0225×10^{23} molecules

n = # mols

[1 kmol = 1000 mol]

[1 mol = 1 gmol]

$M_{air} = 28.97 \longrightarrow 28.97 \frac{\text{g of air}}{\text{mol of air}}$ or $\frac{\text{kg}}{\text{kmol}}$

$M_{water} = 18.0$

$$m = \text{mass} = n \cdot M$$

Ideal gas law: $P\forall = mRT$ or $P\forall = nR_uT$

notation

$\forall$ = volume

V = velocity

R_u = universal gas constant $= 8.314 \frac{J}{mol \cdot K}$

R = specific gas constant $R = \frac{R_u}{M}$

e.g. $R_{air} = \dfrac{8.314 \frac{kJ}{kmol \cdot K}}{28.97 \frac{kg}{kmol}} = 0.287 \frac{kJ}{kg \cdot K}$

- Stoichiometric mass balance

$$aN_2 + bO_2 = cNO$$

- coeff.'s a, b, c are called molar coefficients

To calc. a, b, c, → mass balance

N: $2a = c$
O: $2b = c$
pick $a=1$ → $b=1, c=2$

$$N_2 + O_2 = 2NO$$

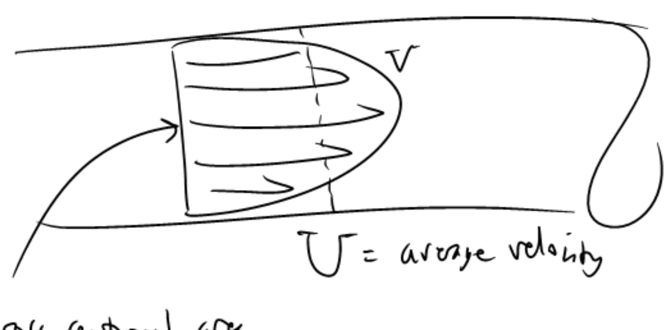
Volume flow rate — Use Q or $\dot{\forall}$

$$\{Q\} = \left\{\frac{\text{volume}}{\text{time}}\right\}$$

units are $\frac{m^3}{s}$, $\frac{m^3}{min}$

$\frac{ft^3}{min}$ → CFM

Flow in a duct,



$$\therefore Q = \dot{\forall} = U \cdot A$$

- Actual Q = Q based on the actual T & P of the gas

in English units we use ACFM
↑ actual

Standard Q = a hypothetical flow rate equal to what the actual flow rate would be at standard temperature & pressure. (STP)

STP → $P_{STP} = 1 \text{ atm} = 101.325 \text{ kPa} = 14.696 \text{ psi}$

$T_{STP} = 25^\circ C = 298.15 \text{ K} = 77^\circ F = 536.67 \text{ R}$

Conversion:

$$Q_{STP} = Q_{actual} \frac{P}{P_{STP}} \frac{T_{STP}}{T} \qquad (1\text{-}16)$$

ALWAYS USE ABSOLUTE T & P in these eq's

$\dot{m}$ = mass flow rate

$$\dot{m} = \rho Q = \rho U A$$

Bulk mass flow rate (air + contaminant)

$\dot{m}_j$ = mass flow rate of species j

$$\dot{m}_j = C_j Q$$

where C_j = mass concentration of species j

$$C_j = \frac{\text{mass of species j}}{\text{unit volume}} \qquad \left[\text{typ. } \frac{mg}{m^3}\right]$$
