Introduction

CVEN 350

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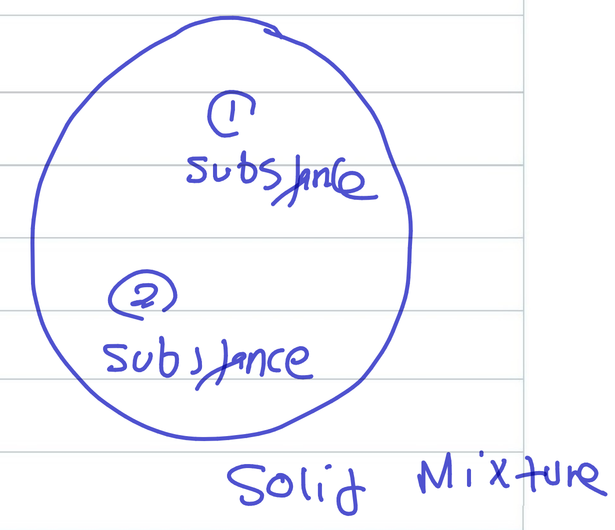
Units

Solids :-

⇓

Concentration



1 Mg/kg = 1 Mg substance per kg solid

= 1 Part per Million by weight

= 1 PPM

1 μg/kg = 1 Microg substance per kg solid

= 1 Part per billion by weight

= 1 PPb

Liquids

⇓

Concentration

→ Mass of substance per unit volume of Mixture

Mg/L , $\mu g/L$, g/M^3

(or)

⇒ Mass of substance per Mass of Mixture

PPM

or

PPb

⇒ Molar Concentrations ⇒ Moles / L (M)

or

⇒ Equivalents / Litres (N)

Common Prefixes

Quant.	Prefix	Symbol	Quant.	Prefix	Symbol
10^{-15}	femto	f	10^{2}	hecto	h
10^{-12}	pico	p	10^{3}	kilo	k
10^{-9}	nano	n	10^{6}	mega	M
10^{-6}	micro	μ	10^{9}	giga	G
10^{-3}	milli	m	10^{12}	tera	T
10^{-2}	centi	c	10^{15}	peta	P
10^{-1}	deci	d	10^{18}	exa	E
10^{1}	deka	da	10^{21}	zetta	Z
			10^{24}	yotta	Y

Perspectives on Concentration

- 1 ppm is one drop in 15 gallons
- 1 ppb is one drop in a large swimming pool (70 m3)
- 1 ppb is 6 people out of the Earth's population

Conversion

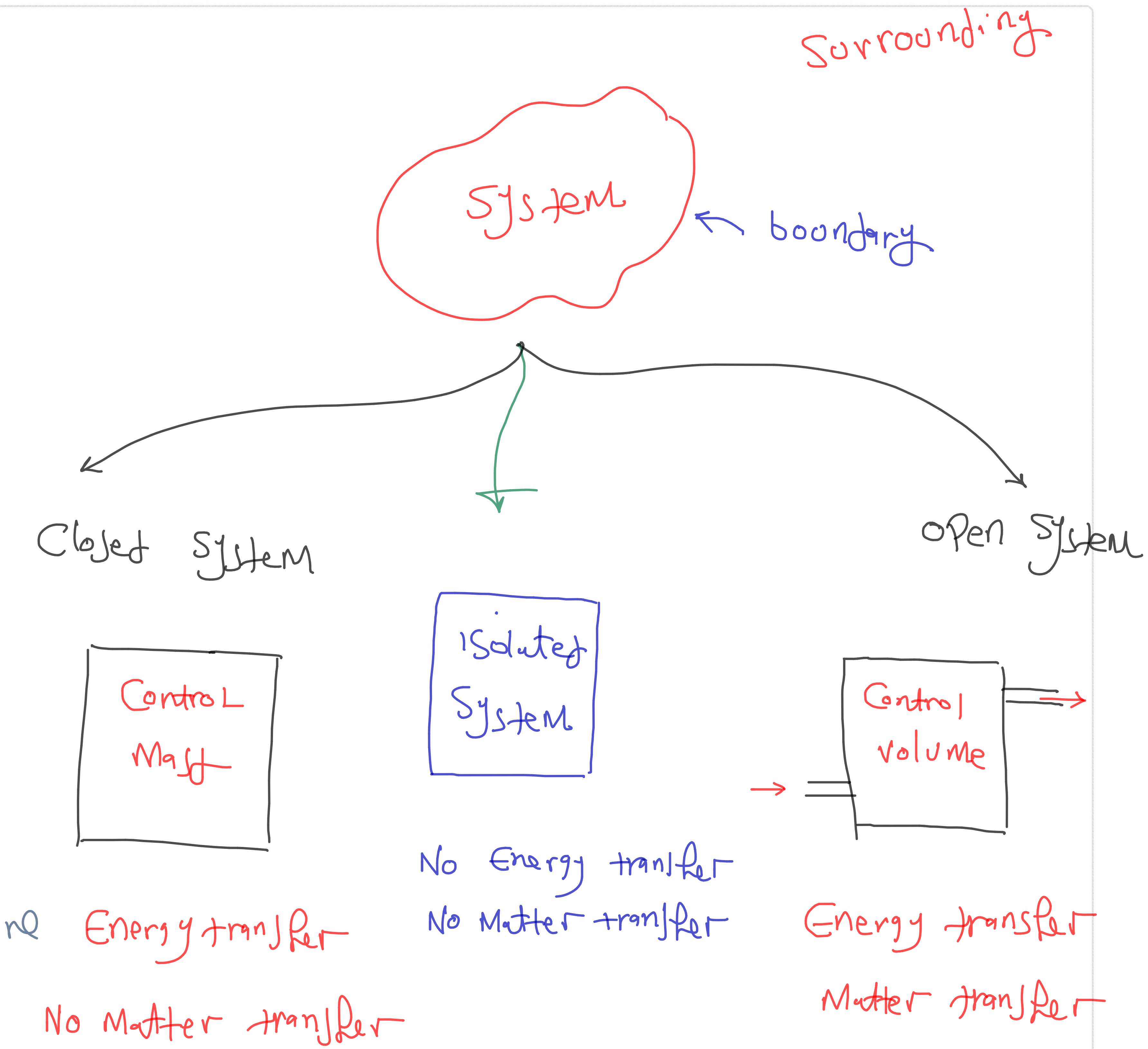
For low Concentration

$$1\ \text{kg of Mixture} = 1\ \text{litre}\ (S.G) = 1\ \text{litre}\left(\frac{\rho_s}{\rho_w}\right)$$

* $1\ Mg/L = 1\ g/M^3 = 1\ PPM$ (by weight)
* $1\ \mu g/L = 1\ Mg/M^3 = 1\ PPb$ (by weight)

For hight Concentration, $1\ kg \neq 1\ litre$

$$Mg/L = PPM\ (\text{be Weight}) \times S.G\ \text{of Mixture}$$



Units of Measurement

TABLE 1

Some Basic Units and Conversion Factors

Quantity	SI units	SI symbol ×	Conversion factor =	USCS units
Length	meter	m	3.2808	ft
Mass	kilogram	kg	2.2046	lb
Temperature	Celsius	°C	1.8 (°C) + 32	°F
Area	square meter	m^2	10.7639	ft^2
Volume	cubic meter	m^3	35.3147	ft^3
Energy	kilojoule	kJ	0.9478	Btu
Power	watt	W	3.4121	Btu/hr
Velocity	meter/sec	m/s	2.2369	mi/hr
Flow rate	$meter^3$/sec	m^3/s	35.3147	ft^3/s
Density	kilogram/$meter^3$	kg/m^3	0.06243	lb/ft^3

$1\ gal = 3.785\ L$

EXAMPLE 1 Fluoridation of Water

The fluoride concentration in drinking water may be increased to help prevent tooth decay by adding sodium fluoride; however, if too much fluoride is added, it can cause discoloring (mottling) of the teeth. The optimum dose of fluoride in drinking water is about 0.053 mM (millimole/liter). If sodium fluoride (NaF) is purchased in 25 kg bags, how many gallons of drinking water would a bag treat? (Assume there is no fluoride already in the water.)

$C = 0.053\ mM/L$

atomic weight $_{Na}$ $= 23\ g/mole$ atomic weight F $= 19\ g/mole$

$Mass\ F = 25 \times \frac{19}{23+19} = 11.31\ kg$

$C = 0.053 \times 10^{-3}\ M/L \ast 19\ g/M \ast 10^{3}\ mg/g$

$= 1.01\ mg/L$

$C = \frac{M}{V} \Rightarrow V = M/C$

$V = \frac{11.31 \ast 10^{6}\ mg}{1.01\ mg/L}$

$= 11.198 \ast 10^{6}\ L$

$= \frac{11.198 \ast 10^{6}}{3.785}\ gal$

$V = 2.97 \ast 10^{6}\ gal$

Gases

1 PPM

1 volume of pollutant per million volumes of the air mixture

$\equiv$ 1 PPM (by volume) = 1 PPM V

Ideal Gas

$$PV = nRT$$

- P → absolute pressure (atm)
- V → Volume (L)
- n → Mass (Mole)
- T → absolute temperature

R = ideal gas constant

$= 0.082056 \ L \cdot atm \cdot K^{-1} \cdot mol^{-1}$

$$K = {}^{\circ}C + 273.15$$

EXAMPLE 2 Volume of an Ideal Gas

Find the volume that 1 mole of an ideal gas would occupy at standard temperature and pressure (STP) conditions of 1 atmosphere of pressure and 0°C temperature. Repeat the calculation for 1 atm and 25°C.

$n = 1$ Mole

$P = 1$ atm

$T = 0°C = 273.15$ K

$R = 0.082056$

(*) $PV = nRT$

$$V = \frac{nRT}{P} = \frac{1 * 0.082056 * 273.15}{1}$$

$= 22.414$ L

(*)

$$V = \frac{nRT}{P} = \frac{1 * 0.082056 * 298.15}{1}$$

$= 22.465$ L