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Summary

Principle 1

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Madar
ask ;; believe & recieve

مواد اولية — معالجة — منتج

*) Chemical Engineering: Raw materials $\xrightarrow{\text{Process}}$ Products

*) In engineering: the numerical values of two quantities may be added or subtracted only of the units are the same.

* لا يمكن جمع أو طرح كميتين عدديتين يمتلكان وحد قياسية مختلفة

eg. 3cm + 5mg = ??? wrong equation

*) A measured (كمية قياسية) or counted (كمية عددية) quantity has:

1) Numerical value (قيمة عددية) 2) Unit (وحدة)

*) A dimension ia property that can be:

1) Measured such as: time, mass, length...

2) Calculated by multiplying or dividing other dimensions

such as: velocity = $\frac{\text{Length}}{\text{time}}$, volume = length^3, density = $\frac{\text{mass}}{\text{Length}^3}$

*) Units are important (أهمية الوحد القياسية) for effective communication and standardization of measurements: (Pounds vs. Kilograms)

* للتواصل الفعال و توحيد القياسات

*) Base Units (رموز): 1) Mass = m 2) Length = L

3) Time = θ 4) Temperature = T 5) Mole = n

*) مضاعفات العدد من أي وحدة نستخدم لتسهيل القيم

*) Multiple Units: 1) Area $= L^2$ 2) Volume $= L^3$

*) مثال ٣ سنوات = 94.608.000 ثانية ، لذلك نستخدم

3) Velocity $= L/\theta$ 4) Acceleration $= L/\theta^2$ 5) force $= m.(L/\theta^2)$

6) Pressure $= m.(L/\theta^2)/L^2 = m.(L^{-1}/\theta^2)$ 7) Energy $= m.(L/\theta^2).L = m.(L^2/\theta^2)$

compound Units

*) Derived Units:

وحدة مشتقة

1) force: $1\,kg.m/s^2 - 1\,N \xrightarrow{Am} 32.174\,lbm.ft/s^2 - 1\,lbf$

2) Pressure: $1\,kg/(m.s^2) = 1\,N/m^2 = 1\,Pa \xrightarrow{Am} 32.174\,lbm/(ft.s^2) - 1\,lbf/ft^2$
$= (1/144)\,lbf/in^2\,(psi)$

3) Energy: $1\,kg.(m^2/s^2) = 1\,N.m = 1\,J \xrightarrow{Am} 32.174\,lbm.(ft^2/s^2) = 1\,ft.lbf$

*) SI and American Engineering System Units:

Dimension	SI Unit	CGS Unit	Am.Eng. Unit
Mass	Kilogram (Kg)	gram (g)	Pound mass (lbm)
Length	meter (m)	centimeter (cm)	foot (ft)
Time	Second (S)	Second (S)	Second (S)
Temperature	Kelvin (K)	Kelvin (K)	Rankine (K)
Mole	grammole (gmol)	gram mole (mol) (g-mol)	pound mole (lb-mol)

*) Conversion of Unit:

*) $\text{Old Unit}\cdot\left(\frac{\text{New unit}}{\text{old Unit}}\right) = \text{New Unite}$

*) $\frac{1}{\text{old Unit}}\left(\frac{\text{old unit}}{\text{New Unit}}\right) = \text{New unite}$

eg: Express $300\,cm^{-2}$ in mm^{-2}:

ans: $\frac{300}{cm^2}\left(\frac{1cm}{10mm}\right)^2 = \frac{300}{\cancel{cm^2}}\left(\frac{\cancel{1cm^2}}{100mm^2}\right) = \frac{3}{mm^2} = 3\,mm^{-2}$

*) Force and Weight:

*) Newton's second Law: force is proportional to the product of mass and acceleration (Length/time^2)

*) Natural Force Units: *) Derived Force Units:

1) SI = $Kg.m/s^2$ = 1 Newton (N)

2) CGS = $g.cm/s^2$ = 1 dyne

3) Am.eng = $lb_m.ft/s^2$ = $\frac{1}{32.174}$ lbf

Conversion factors between natural and derived force units.

*) Weight: force exerted on the object by gravitational attraction ($W = mg$) $g = 9.8066 m/s^2 = 980.65 cm/s^2 = 32.174 ft/s^2$

*) Scientific Notation: a number is expressed as the product another number (usually between 0.1 and 10) and a power of 10.

e.g: $123000000 = 1.23 \times 10^8$ or 0.123×10^9

e.g: $0.000028 = 2.8 \times 10^{-5}$ or 0.28×10^{-4}

*) Significant Figure: the digits from the first nonzero digit on the left to either:

a) the last digits (zero or nonzero) on the right if there is a decimal point, or (b) the last nonzero digit of the number if there is no decimal point.

e.g: $23,040 = 2.304 \times 10^4$ = 4 Sig. fig

e.g: $0.035 = 3.5 \times 10^{-2}$ = 2 Sig. fig

*) In Multiplication / Division: The number of sig. fig in the product or quotient is equal to the lowest number of sig. fig of any of number.
العدد الأقل في الضرب والقسمة

e.g: $3.23 \times 4.125429 = 13.32513567 = \underline{\underline{13.3}}$

3 sig.fig $\times$ 7 sig.fig $=$ 3 sig.fig

*) In Addition / Subtraction:

1) Compare position of last sig.fig relative to the decimal point.

* العدد الأخير الأقرب للفاصلة مع تقريب باقي الأعداد قبل الحذف.

2) The position farthest to the left is the last permissible sig.fig for the sum or difference.

تقريب

e.g: $3.\underbrace{23}_{2\ \text{البعد}} + 4.\underbrace{125429}_{6\ \text{البعد}} = 7.\underline{35}5429 = \underline{\underline{7.36}}$

*) Dimensionless Quantites:

*) Reynolds Number $= \dfrac{\overset{Kg/m^3}{\rho}\ \overset{m}{D}\ \overset{m/s}{v}}{\underset{Kg/m.s}{\mu}} = \dfrac{\frac{Kg}{m^3} \cdot m \cdot \frac{m}{s}}{\frac{Kg}{m.s}} = \dfrac{\cancel{Kg} \cdot \cancel{m} \cdot \cancel{m} \cdot \cancel{m.s}}{\cancel{Kg} \cdot \cancel{m^3} \cdot \cancel{s}} = 1$

*) Importance of Dimensionless Quantities:

*) Used in arguments of special functions such as exponential, Logarithmic, or trigonometric functions.

e.g: e^{10} is ok $\underline{\underline{\text{but}}}$ $e^{10 ft}$ is undefined.

e.g: $\cos(10)$ is ok $\underline{\underline{\text{but}}}$ $\cos(10 ft)$ is undefined.

*) Dimensionless Quantities:

بدون وحدة

*) Consider the Arrhenius Equation: $K = A \cdot \exp(E/RT)$

نفس الوحدة

Where: 1) E = Activation energy (cal/mol)

2) T = Temperature (K)

*) What is the Unit of R?

ans: $\frac{E}{RT}$ is exp $\longrightarrow \frac{E}{RT} = 1 \longrightarrow \frac{\frac{cal}{mol}}{R \cdot K} = 1 \longrightarrow \frac{cal}{K \cdot mol} = \frac{R \cdot K \cdot mol}{K \cdot mol}$

$\boxed{R = \frac{cal}{K \cdot mol}}$ To make the argument of the exponential function dimensionless.

*) Process Data Representation and Analysis:

تجربة — القياسات

*) Experiment: Collection of (measurements) data, each represented by number which give us information about the quantity being determined. (The number may occur once or it may be repeated)

*) جمع البيانات ، تمثل بالأرقام والتي تعطينا معلومات حول الكمية التي يتم تحديدها.

*) Errors: Personal / insomantal

*) خطأ شخصي (كسبب رقم خاطئ بالنظر)

*) خطأ بسبب الآلة (كل جهاز يحتوي نسبة خطأ)

*) This is due to Variability of measurements arising form inaccracies i.e. errors

*) يرجع ذلك إلى تباين القياسات الناتج عن عدم الدقة أي الأخطاء

توزيع التردد

*) We display measurements as: Frequency Distribution.

e.g: What is the true value of the quantity being measured call it x (random variable) N measurements?

ans: We have estimate of the true value X Sample mean (arithmetic mean): $\bar{X} = \frac{1}{N} \sum_{i=1}^{N} x_i$ *) مجموع القراءات تقسيم عددهم

*) Scatter of data (Variable X) with respect to their mean value can be characterized by:

*) نجد دقة القيم الناتجة

1) Range $R = X_{max} - X_{min}$

أصغر - أكبر

(الأقل أفضل)

2) Sample Variance $S_x^2 = \left(\frac{1}{N-1}\right) \left[\sum_{i=1}^{N} (x_i - \bar{x})^2\right]$

(الأقل أفضل)

مجموع مربع الفرق بين القراءة والناتج مقسوم على عدد القراءات - واحد

3) Sample Standard Deviation $S_x = \sqrt{S_x^2}$

نسبة

تستخدم لإيجاد الError

*) Value of measured value: $X = \bar{X} \pm \text{Error} \rightarrow = (X_{max} - X_{min})$ or $= (S_x, 2S_x, 3S_x)$

*) Process Data Representation And Analysis:

*) The operation of any chemical process is ultimately based on the measurement of Process variables.

متغيرات العملية

Such as: Temperatures * pressures * Flow rates * Concentrations

PRINCIPLES

*) It is sometimes possible to measure these variables Directly, but as a rule Indirect techniques must be used.

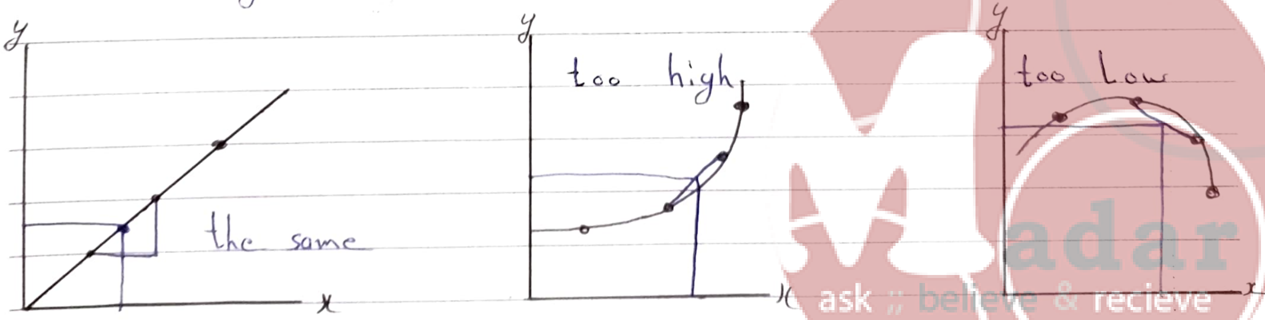
e.g: To measure the concentration (C) of a solute in a solution, we normally measure a quantity (X) such as thermal or electrical conductivity, a light absorbance or the volume of a titer, and then calculate (C) from the measured value of (X) Calibration Curve

*) نستخرج قيمة التركيز من قيمة (x) عن طريق العمليات المختلفة على شكل نقاط

*) Our object is to use the calibration data to estimate the value of for a value of between tabulated points (interpolation) or outside the range of the table data (extrapolation).

*) Two point linear interpolation: $y = y_1 + \frac{x - x_1}{x_2 - x_1}(y_2 - y_1)$

*) If the function graph y(x) contains an inclination, the values of y become:



*) Linear Regression: $y = mx + b$, Where:

y = dependet x = independet m = slope b = intercept

e.g: $y = \frac{1.3 \times 10^7 \sin(2x)}{x^{\frac{1}{2}} + 58.4} \rightarrow \frac{1}{y} = \frac{x^{\frac{1}{2}} + 58.4}{1.3 \times 10^7 \sin(2x)}$

$$\underbrace{\frac{\sin(2x)}{y}}_{y\text{ axes}} = \frac{\overbrace{x^{\frac{1}{2}}}^{x\text{ - axes}} + 58.4}{1.3 \times 10^7}$$

*) What is regression analysis?

*) A technique for modeling and analyzing the relationship between 2 or more variables. Usually, 1 variables is

*) Purpose: Establish a mathematical relation between the variables.

* Fitting a straight line to a Set of data Point calculating the slope m and intercept b using the method of least squares: $m = \frac{n(S_{xy}) - (S_x S_y)}{n(S_{xx}) - (S_x)^2} = \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n} (x_i - \bar{x})^2}$

$$b = \frac{S_y - m \cdot S_x}{n} = \bar{y} - m \cdot \bar{x}$$

$S_x = \sum_{i=1}^{n} x_i$ | $S_y = \sum_{i=1}^{n} y_i$ | $S_{xx} = \sum_{i=1}^{n} x_i^2$ | $S_{xy} = \sum_{i=1}^{n} x_i y_i$

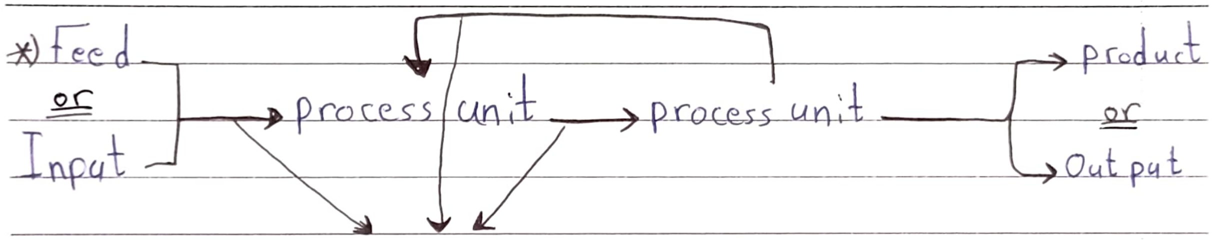
*) Chemical Process:

*) A process is any operation or series of operations by which a particular objective is accomplished.

*تحقق هدف معين.

*) A chemical process is any operation or a series of operations by which a particular product is produced from raw materials.

*تحول المادة الخام لمنتج نهائي.



*) What we want about these streams?

ans: Temperature * pressure * mass flow * volumetric flow * chemical composition.

*) Some of those variables will be given, others we measure But many we have to calculate such as (mass flow and material balance) Ch4 (energy balance, heating, cooling ... etc) PRI 2

*) The Process unit : modeling * designing * sizing costing unit operations.

*) What is a $\underbrace{\text{(chemical)}}_{CP}$ process variable ?

*) Any measurement used to characterize or describe (C.P)

we have : 1) measurements to quantify a material or

*لتقدير مادة أو تركيبة كيميائية.

specify a chemical composition (Mass * Volume * Mole)

*لتحديد شروط العملية.

2) measurements used to specify process conditions (Pressure * Temp.)

*) Density (ρ) : mass per unit volume

$$\rho = [kg/m^3] = [lb_m/ft^3] = [g/ml]$$

كمية

*) ρ : Used as conversion factor between (mass and volume) or

mass سرعة تحرك الكتلة ع وحدة زمن

*يستخدم التركيز للتحويل بين الكتلة والحجم

(flow rate and volumetric flow rate of a process stream)

اعتماد بشكل قليل على الحرارة

*) Liquid and solid densities vary slightly with Temperature

سائل صلب

أعتماد بشكل كبير حرارة ضغط

*) Densities of gas depend heavily on temperature and pressure.

غاز

* Specific volume : volume occupied by unit mass $= \frac{1}{\text{density}}$

*) Specific gravity: Ratio of a density of a substance to the density of a reference substance $(SG = \rho/\rho_{ref})$

*) Typical Reference Density = water at 4°C and 1 atmosphere

*) Value: $\rho_{ref} = 1.000\,g/cm^3 = 1000\,kg/m^3 = 62.43\,lb_m/ft^3$

*) SG is given at particular temperature (dose not have to be the reference temperature)

*) To get density (ρ) from SG: $\rho_A = (SG_A)(\rho_{H_2O,ref})$

$$SG_A = \frac{\rho_A}{\rho_{H_2O,ref}}$$

$$\rho_H = \frac{P}{\rho g} = \frac{m}{V} = \frac{\dot{m}}{\dot{V}}$$

*) The kinetic energy of substance produces:

1) Potential energy. 2) Temperatures.

*) Temperature units:

1) Kelvin (K) 2) Celsius (°C)

3) Fahrenheit (°F) 3) Rankine (R°)

*) Temperature conversions:

1) $K = °C + 273.15$ 2) $°R = °F + 459.67$

3) $°R = 1.8\,K$ 4) $°F = 1.8\,°C + 32$

5) $\Delta °C = \Delta K$ 6) $\Delta °F = \Delta °R$

7) $\Delta °C = 1.8\,\Delta °F$

*) Pressure = force / Area

Atmosfer الجوي
وزن عامود الهواء الساقط

Absolute
⊕ always

Gauge

$$P_{Absolute} = P_{Atmosfer} + P_{Gauge}$$

* $Pv = RnT$

*) The average molecular weight:

1) $\bar{M} = y_1 M_1 + y_2 M_2 + \ldots$ 2) $\frac{1}{\bar{M}} = \frac{x_1}{M_1} + \frac{x_2}{M_2} + \ldots$

*) Fluid pressure in:

1) Tank and a pipe $\Rightarrow P = P_o + \rho g h$

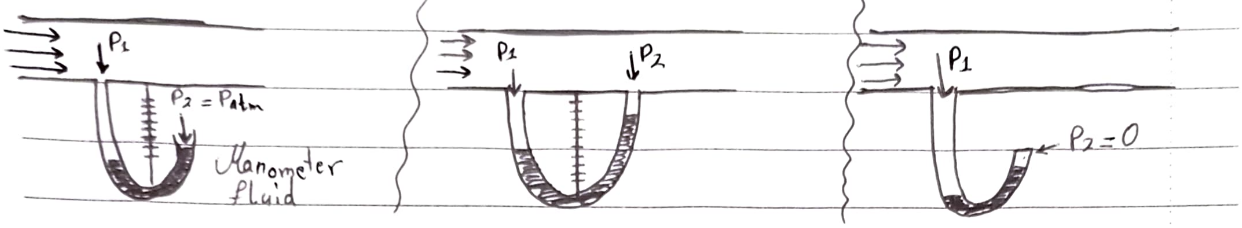
2) At The base of a fluid column $\Rightarrow P\left(\frac{F}{A}\right) = \rho_{fluid}\, P_h$ (head of fluid)

*) Manometers:

1) Open-end

2) Differential

3) Sealed-end



*) General Manometer Equation: $P_1 + \rho_1 g d_1 = P_2 + \rho_2 g d_2 + \rho_f g h$

*) Differential: $P_1 - P_2 = (\rho_f - \rho) g h$

*) for gases: $P_1 - P_2 = h$

*) The pressure in a manometers full of mercury is gevin

٭ يكون الفرق بين فرعي المانوميتر المحتوي على الميركوري معطياً بـ(المسافة) ميركوري

by (The difference in length) mercury or any matter

*) Process classification :

1. Batch process.
- inputs : ones (ع الدفعة)
- outpats: ones (ع الدفعة)
- Process: in a cloce sestgm (عملية مغلقة)

2. Continuous Process.
- inputs: continuously (مستمر)
- outputs: continuously (مستمر)
- Process: in a open sestym (عملية مفتوحة)

3. Semi batch Process.
- inputs: (one of them continuously and the other onse)
- outputs:
- process: semi open

*) Another classification of process :

1. Steady-state ثوابت

⊛ If the values of all variables in a process don't change with time. مع الزمن

⊛ Variables: volumes * pressure * flow rates, temperature

2. Unsteady-state متغير

⊛ If any of the process variables change with time. مع الزمن

*) Unsteady state $\xrightarrow{\text{such as}}$ Batch * Semi batch * Continuous.

*) Steady state such as, Continuous.

*) General balance equation :

مدخل + التوليد − مخرج − الاستهلاك = التراكم

Input + generation − output − consumption = accumulation

*) Types of balance :

Differential (لحظية) indicates what is happening in a system at an instant in time. (ع لحظة من التفاعل)

(Continuous steady system)

Per time

$\Delta t \to 0$

Integral describe what happens between two instants of time. (بداية ونهاية التفاعل)

(Batch system)

(repeat) مكرر

t_i t_f

*) Important Rules :

اذا كانت الكمية المحسوبة هي الكلية

*) If the balanced quantity is the total mass:

1) generation = 0   2) consumption = 0

باستثناء التفاعلات النووية

except in nuclear reactions, mass can't be created or destroyed.

*) If the balancd substance is a non-reactive species (neither a reactant nor a product): 1) generation = 0 2) consumption = 0.

بغض النظر

*) If a system is at steady state, accumulation = 0, regardless of what is being balanced. By definition in a steady state system

لا يمكن أن يتغير شيء بمرور الوقت بما في ذلك الكميات.

nothing can change with time including the amount of the quantity

*) Balances on continuous steady state processes:

*) accumlation = 0 ⇒ input + generation = output + consumption

مواد غير متفاعلة

*) if it is on a non-reactive species or total mass ⇒ input = output

*) Integral balances: Initial input + gen = final output + Consumption

*) Material balance calculation: the best way to solve it by drawing the system.

PRINCIPLE

حفظ الكتلة (قانون)

*V.I always mass in = mass out (conservation of mass)

*) The best way to solve any question:

جد

1) **Find** what is the question asking for such as

عبارات — افتراضات

key words * phrases and be careful of assumptions.

ارسم

2) **Draw** a picture for the system and locate the stem.

حدد — * مش شرط رسمة جديدة، على نفس الرسمة.

3) **Label** knowns + unknowns in the picture

as example put: m → mass * n → moles * x → mass.f * y → mole.f

اكتب — تذكر

4) **Write** a mass balances remember that you can

معادلة لكل مادة

Write an 1 mass balance for every component

$$ex: m_{1stem} + m_{2stem} + m_{3stem} \ldots \underline{\underline{in}} = m_{1stem} + m_{2stem} + m_{3stem} \ldots \underline{\underline{out}}$$

*) then write overall balance and substitute 1 overall balance for 1 component balance.

*) and be careful of when you do your mass balances

كل واحدة — & تعتبر (مستقل)

thate each one of your balances in independent.

يجب حسابها قبل خطوة ٤

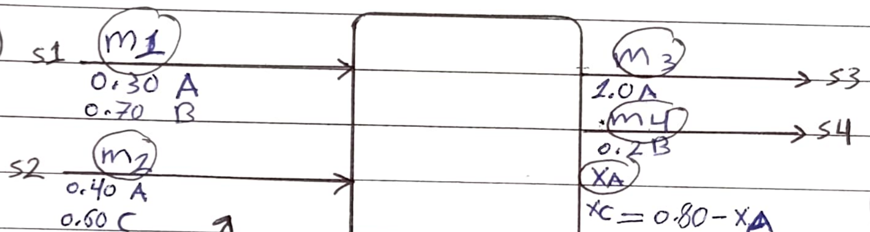
*) After no 4 you shold calculate the DOF

نستطيع حسابها بعد قليل.

*)ex: Two streams enter a column. Stream 1 is 30% A and the rest is B. Stream 2 is 40% A and the rest is C. Two streams exit the column. Stream 3 is 100% A, while stream 4 is 20% B and the rest is A and C.

An: 1) we have 4 stream * 3 component * 1 column with 4 information and asking for m.b

2)



3) Labiling

*) we have 5 unknowns.

4) A: $0.30 m_1 + 0.40 m_2 = m_3 + X_A m_4$

B: $0.7 m_1 = 0.2 m_4$

C: $0.60 m_2 = X_C m_4$

$m_1 + m_2 = m_3 + m_4$

*) if we add all of it together we will get overall balance so we can used 3 of them to solved the system.

*) In DOF we have 5 unknowns and 3 balances So we can't solved the system.

*) DOF → Degree (درجة) Of freedom (الحرية) :→ It is show as if we have enough or to much information to solve problem.

*) DOF = $n_{unknown} - n_{equ}$ ← (Just for non-reactive)

$= n_{unknown} - n_{independent\ balance} - n_{other\ equ}$

$n_{independent\ balance} = n_{species}$

$n_{other\ equ}$ cold be a: Process specification (توصيفات العملية) / Physical Properties data (الخواص الفيزيائية)

If

< 0
*over specified
* The problem can be solved but there ~~an~~ are more than we need of equ

> 0 (محدد)
* under specified
* the problem can't be solved.

= 0
* the problem solved

*) When we have more thane 1 process or column in the problem we shold calculate the DOF for each one of them then start from DOF = 0

* في المسائل المتعددة نحسب لكل واحدة ثم نبدأ من التي تساوي صفر.

*) Splitting point : a point have the same concentration like the all or the center (eg: a cup of Juice)

have → Produce in other stem

* نقطة تحوي تركيز مثل الأصل ، مثال عند سكب كأس عصير من العلبة.

*) Mixing point: a point Produce a new concentration in every steam. (in Recycle system)

* تعطينا تركيز جديد للمواد. وغالبًا تكون في نظام إعادة التدوير.

قياس العناصر الكيميائية للتفاعل — النظام التفاعلي

*) Chemical reaction stoichiometry (on reactive system):

⊛ The stoichiometric coefficients: tell us the **mole** (not mass) relationships (stoichiometric ratios) of the compounds participating in the reaction.

النسب المتكافئة

eg: $2A + 3B \longrightarrow 5C + 7H$ ⇒ mean: 2 gmol of A reacts with 3 gmol of B to yield 5 gmol of C and 7 gmol of H.

*) Mole ⇒ is Avogadro's number of particles $= 6.23 \times 10^{23}$

$$\text{Mole} = \frac{\text{Mass}}{\text{Molecular Weight}} \longrightarrow \frac{m}{M_w}$$

and we use it because it is fixed number and easy to deal with.

⊛ we use Mole instead of number of molecules.

*) In balanced chemical equation: Atoms in = Atoms out

*) Stoichiometric coefficien: The numbers that precede the formulas for each species.

1) negative (سالب) for reactants (للمتفاعلات) 2) Positive (ايجابي) for products (للنواتج)

PRINCIPLE

stoichiometric ... stoichiometric

*) Ratio (mole A / mole B) in feed = Ratio from the balanced equ

*) In general: $aA + bB \longrightarrow cC + dD$ where (a/b/c/d) are the stoichiometric coefficients, representing the molar balance of the equation.

موزونة ... صحيحة

*) The equation must be balanced to be Valid, i.e number

نفس عدد الذرات على كل جانب

of atoms of each specis are the same on both sides becuse

لا يمكن ... صنع ... أو ... تدمير ... في التفاعلات

(atoms can't be created or destroyed in chemical reaction)

*) By calculation: $\gamma_1 C_1 + \gamma_2 C_2 = \gamma_3 C_3 + \gamma_4 C_4$

$$\therefore \sum \gamma C = 0$$

*) The sempol of stoichiometric coefficient is (γ).

*) Stoichiometric ratios : $\frac{\text{mole consumed}}{\text{mole produced}}$ eg: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

$$S.R = \frac{2 \text{ mole } O_2 \text{ consumed}}{1 \text{ mole } CO_2 \text{ produced}} = 2:1$$

*) Limiting reactant is reactant that is copletly consumed first when a reaction is run to completion, depends on feed

*) fractional excess: is the ratio of the amount by which the feed exceeds stoichiometric requirements in moles divided by the stoichiometric requirements in moles.
⊛ نسبة الداخل بالنسبة للمطلوب.

So fractional excess of A = $\dfrac{(n_A)_{feed} - (n_A)_{stoich}}{(n_A)_{stoich}}$.

*) Chemical reactions proceed quite slowly. ببطء شديد

*) It is not practical to design a reactor for complete conversion of the limiting reactant. Instead, the reactant is separated from the reactor outlet stream and recycled back to the reactor inlet.
ليس عملي — تصميم — الكامل
⊛ يتم فصل المادة المتفاعلة من تيار خارجي ثم تعاد مرة أخرى إلى النظام/المدخل.

*) fractional conversion (f) = moles reacted \ moles fed.

⊛ In general, for → $A + \frac{b}{a}B \longrightarrow \frac{c}{a}C + \frac{d}{a}D$

$$f_A = \frac{n_{A_0} - n_A}{n_{A_0}} \longrightarrow n_A = n_{A_0}(1 - f_A)$$

$$n_C = n_{C_0} + \frac{c}{a} n_{A_0} f_A$$

*) The extent of reaction (ξ or $\dot{\xi}$) is the amount in mole that converted in a given reaction normalized to Stoi equ

1) For batch process : $n_i = n_{i0} + \nu_i \xi$ where
1) n_i = mole of i (component)
2) n_{i0} = mole of i (species)
3) ν_i = stoichiometric cof.

*) The (ξ) has the same unit of (n) (mole, kg-mol ...)

2) for continuous process, steady state: $\dot{n}_i = \dot{n}_{i0} + \nu_i \dot{\xi}$ where
1) $\dot{n}_i$ = molar flow (exiting)
2) $\dot{n}_{i0}$ = molar flow (fed)
3) ν = stoichometric cof.

*) The ($\dot{\xi}$) has the same unit of ($\dot{n}$) (mole/time)

So, 1) $\xi = \dfrac{n_i - n_{i0}}{\nu_i}$ 2) $\dot{\xi} = \dfrac{\dot{n}_i - \dot{n}_{i0}}{\nu_i}$

*) The final (equilibrium) composition of the reaction mixture is determined by Chemical Thermodynamic

الوزن

* يتم تحديد الوزن النهائي للمعادلة من خلال (الديناميكا الحرارية)

*) The time needed for a system to reach a specified state short of equilibrium is determined by Chemical Kinetic.

* يتم تحديد الوقت اللازم من خلال (الكيمياء الحركية)

*) Reactions:

Irreversible (Reactants → Products)
* The reaction proceeds only in a single direction and the concentration of the Limiting reactant eventually approaches Zero

Reversible (Reactants ⇌ Products)
* reactants from products and products undergo the reverse reactions to reform the reactants.

*) in the reaction: $aA + bB \longrightarrow cC + dD$

if all compon is gases then the equ constant (K) =

$$K = \frac{P_C^c * P_D^d}{P_A^a * P_B^b}$$ → products / → reactants

Wher:

1) P is the partial pressure for gasses.

$$P_A = y_A P \longrightarrow K = \frac{y_C^c \; y_D^d}{y_A^a \; y_B^b}$$

y_A: mole fraction; P: total pressure

*) In many processes, reactants are put together in order to make a product.

*) Yield: $\dfrac{\text{mole of desired product formed}}{\text{mole formed at 100\% conversion}}$ (fraction)

* عدد المولات الناتجة

* عدد المولات في العملية المثالية دون هدر او خسارة

*) Selectivity: $\dfrac{\text{mole of desired product formed}}{\text{mole of undesired product formed}}$ (not fraction)

* عدد المولات الناتجة من المطلوب

* عدد مولات المواد الأخرى الناتجة

*) for multiple reactions, each independent reaction has its own extent.

*) If a set of a reaction takes place in a batch or continuous steady-State reactor: $n_i = n_{i0} + \sum_j \nu_{ij} \xi_j$ where j is a reaction

n_i: عدد المولات الخارجة

n_{i0}: عدد المولات الداخلة