NIC ASIA

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Date: 01/09

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Temp → (295 K − 330 K)

Chemical Engineering

→ Milk → Emulsion.

CO has both calorific value and (net and gross)

Gashol ⟶ Alcohol and Petrol

Euler number → $\frac{\text{Inertia force}}{\text{pressure}}$

Dynamic Viscosity ⟶ $ML^{-1}T^{-1}$

weight → buoyancy + drag

Prandtl number → $\frac{\text{Momentum diffusivity}}{\text{Thermal diffusivity}}$

$$\frac{1}{U} = \frac{1}{U_0} + R_{fo}$$

In absorber → Operating line lies above equilibrium line

Multistage tray tower: Reflux ratio ↓

→ Infinite trays and max. reboiler heat load.

Stripping section in cont- distillation column

→ liquid is enriched with high boiler.

rectifying section

→ Vapor is enriched with high boiler

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Electricity Maps Com

→ 3 Way catalyst is feasible in lean mixture (stoichometric)

Dividing tall packed tower into series
→ Avoid channeling.

→ Rate of adsorption $\propto \frac{1}{T}$

→ Uniform concentration → Murphree efficiency = point efficiency

→ Rate of extraction in leaching $\propto T$
→ Concen of rubber latex → Agitated film evaporator

→ Not a continuous leaching equipment
⇒ Pachuka tank

→ MEA absorbs H_2S
→ Gaseous diffusion process → Isotopes of uranium
→ Rasching rings → packing used in Industry

→ Plate efficiency → A function of mass transfer betwn liquid and vapor

→ Cox chart → log P vs T
→ Chemisorption → An irreversible phenomenon
→ Back trapping ↓ tray efficiency

→ Absorber factor (A) in absorber ⇒ > 1
→ Tower diameter ↓ tray spacing ↑
→ channeling → > 8 : 1
→ Rault's law applies to → solvents

W.T – AST → +ve

→ P-controller has maximum offset
→ Composition of alloys ⟶ Polarograph.
→ Vane meter → Flow rate of river.

→ Single tank system → T.F ⇒ $\frac{R}{TS+1}$
→ Bourdon tube → Secondary element
(bulb → Primary element)

→ frequency response method containing transportation lag stability of a control system

→ Optical radiation pyrometer → 800°C – 1200°C
→ Positional controller → high loads
P-I control → eliminates offset

→ First empirical temp scale → Fahrenheit scale
→ Mass spectrometer → Composition of isotopes analysis

→ Introducing I control → reduce offset
→ Hot wire anemometer → Not a composition measuring instrument
Decay ratio ∝ $\frac{1}{\text{overshoot}}$

→ Bare mercury in glass thermometer → Not a 2nd order
→ stabilishing time → 95% of ultimate value.

→ Triple point of water
(273°K, 32°F, 492°R)

→ 1st order system response → $\left(0, \frac{\pi}{2}\right)$

→ Phase margin → 180° − phase lag.

→ Wrong stats (CO_2 is the strongest paramagnetic gas)
O_2 is the strongest paramagnetic gas

→ Psychrometer → Humidity of gases

→ CSTR → Air to open valve controller indirect acting.
→ Photo electric pyrometer → (800 − 1300°C
Number of poles in $\frac{1}{s^3+2s^2+1}$ is → 3

Bourdon gauges → 2 gauge

Dynamic characteristic → (Reproductivity, Dead zone, static error)
High fidelity → Desirable characteristic

Static characteristic → Drift

Phase shift → (−45°C)
(for 1mm and 1 rad/min)

→ freezing point of mercury → $-38.9°$
($-39°$ − 350)

→ Load cells → Weight measurement

→ Amplitude ratio for the sinusoidal response of 1st order system is <1

→ Transportation lag is 1 (Amplitude ratio)

→ Helium in thermometer → < 0°C

→ Dynamic error → 2AT for ramp input in 2nd order system

→ Open loop T.F → Nyquist stability method.

→ Alphatron measures pressure > 3 microns

$\frac{2s+1}{4s}$ → 1st order TF

Oil → Used in hydraulic controller

→ Unbound input T.f ⇒ $\frac{1}{s^2}$
→ Manometer → Gauge pressure

→ Pitot tube → static pressure
→ Barometer → Absolute pressure
→ Amplitude ratio of 0.1 → −20 decibels
→ Mercury barometer → Atmospheric pressure

Magnetic flow meter → Not a variable area flowmeter

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→ Platinum - Platinum rhodium → −50°C Temp

→ Variable area Flowmeter
(Piston type meter, Rotameter, Orifice and tapered plube meter)

→ Copper - constantan thermocouples → least temp measurement
→ Reset rate → Integral time

→ Thermocouple in thermal well
⇒ Multiple 1st order system

→ 12, 0.6, 0.12

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ICRE

→ $\frac{1}{k_{of}} = \frac{1}{k} + \frac{1}{k_g}$, Knudson diffusion $\propto \sqrt{T}$

→ half life period ⇒ $\frac{0.693}{k}$

→ Higher free energy (A·E) → slowers rate of reaction.

→ Eddy diffusivity in liquid for PFR ⇒ 0

→ CSTR → Auto thermal reaction.
→ Negative catalyst → reduce rate of reaction.
→ Auto clave → High pressure batch reactor

Unit of $\frac{E}{R}$ ⇒ °K

→ Inversion of cane sugar → Bimolecular reaction with 1st order

→ Glucose $\xrightarrow{\text{Zymase}}$ Ethyl alcohol

→ Effectiveness factor of catalyst → Pore diffusion

2A → B (CSTR and PFR reactor)
→ Conversion high is PFR.

→ for 10°C ↑ r ⇒ 2, 30° to 70°C
r ⇒ 16 times

Ar corvose

→ 0.144

$r =_r \to 2^9 = 512$

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A → 3B · (50 % of A

→ Mole fract of A is $\frac{1}{4}$

→ Half life period is independent of initial conc of reactant

→ Variation of one concentration term → 1st order

Transition state theory → $k \propto T \cdot e^{-\frac{E}{RT}}$

→ PFR → presence of lateral mixing.

ice ⇌ water Pressure increase

→ More water will be formed.

Radioactive decay → 1st order kinetics:

→ Step input signal response → C – curve

$N_2 + O_2 \rightleftharpoons 2NO$ (No change in P ↑)

→ As the chemical reaction proceeds.

↳ the rate of reaction ↓

Physical adsorption → 1000 $\frac{kcal}{kg\ moles}$

→ $r_A = k C_A C_B$, V ↓ $\frac{1}{4}$ times

→ r → 16 times

$E_a \Rightarrow \frac{E_D}{2}$

$\frac{\text{Mean residence time}}{\text{space time}} = 1$

(B is constant

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→ BET apparatus → specific surface of a porous catalyst

→ Sequence of reaction in 2nd order.
→ 15, 10, 5

→ $-r_A = \frac{k P_A \cdot P_P \cdot P_B}{1 + k_A \cdot P_A + k_C \cdot P_C}$

→ rate controlling step for this reaction.
→ A and B in gas phase (surface reaction)

→ Unreacting core model → Reacting of sulphide ores

→ Half life period → $\frac{1}{2}$ of initial concⁿ. of reacting subst

Participation of electrons → chemical reaction

Temp ↓ → Endothermic reaction conversion ↓

Ef of catalyst increase
→ Catalyst size ↓ and catalyst diffusivity ↑

→ $\frac{\alpha}{8}$ doesn't take part in chemical reaction

Shift reaction → $CO \rightarrow CO_2 + H_2O$

$A \rightarrow 2R$
$A \rightarrow 3S$] → $\frac{2}{3}$

$C_A \downarrow$, $C_B \uparrow$

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$$E.F \Rightarrow \frac{1}{L\sqrt{k/D_1}}$$

Parformance equation are similar → ρ constant
(PFR and batch reactor)

$\cdot SO_2 \longrightarrow SO_3$ (H_2SO_4)
→ Yield will increase if ($T \downarrow$ and $P \uparrow$)

→ RTD of an ideal CSTR reactor is $e^{\left(\frac{-t}{\tau}\right)}$

$A + B \longrightarrow R$, $r_R = 2C_A^{0.5}C_B^{2}$
$A + B \rightarrow \cdot S$, $r_S = 1.5\, C_A \cdot C_B$

→ Low C_A, high C_B

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Chemical Process

→ N_2H_4 → Rocket fuel. (Hydrazine)

→ Sugar content in sugarcane → 5 - 10 %
→ Paper grade bamboo contains → 5 % cellulose

→ Production of 1 ton Cement → 1.2 tons of Limestone

→ Blotting paper → No requirement of filler

→ Phenolic antiseptic → Medicated soaps

→ Lead chromates → Yellow Pigment
→ Sweetest sugar → Fructose

→ Froth flotation → Conc^n of sulphate ore

→ H_2SO_4 → (furnace → converter → absorber)
→ Margarine → is a fat

→ Cumene (raw material) for → Phenol and acetone
→ Molasses (starting raw material) → Alcohol

→ Flexible foam → (Polyurethanes)

→ N_2 is an essential component → Proteins calcination zone → 1000°C

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→ SO_2 → SO_3 (Low T, high P)
→ Liquid nitrogen → (Refrigerative cooling)
→ Na_2CO_3 → (Soda ash)

→ Washing soda → ($Na_2CO_3 \cdot 10H_2O$)
→ Baking soda → ($NaHCO_3$)

→ Dehydration of isopropanol → Acetone
→ Kraft pulp → Alkaline process

→ Ethylene $\xrightarrow[\text{produced from}]{\text{(Hydrocracking)}}$ Naptha

→ Neoprene ⟶ (Synthetic rubber)
(Polychloroprene)

→ H_2S is absorbed by using → Ethylamine

→ Boiling of water → CO_2 as temporary hardness

→ Purpose of tanning → Stiffen the leather

Nylon - 6 → Polyamide → (Caprolactam)

(Hexamethylene diamine and Adipic acid) → Nylon 66

$(CO + H_2)$ → [Producer gas, Water gas, Coke oven gas)

Teflon → C_2F_4 (PTFE)

HCl → Muriatic acid

→ Average Mol. wt → $\dfrac{\text{Saponification number}}{\text{Number of oil / fats}}$

→ Oleum produces fumes of → SO_3

Unsaturated oil ⇔ Saturated oil.

→ Melting point low ; higher reactivity to oxygen.

→ Wrought iron → Purest form of iron.

→ Thinner in paints → Suspend pigments and dissolve film forming materials.

→ Bosh process → H_2 producing from $(CO + H_2O)$

→ Linolic acid → Main constituent of seed oil

→ Cellulose → Main constituent of cotton fibre

→ Yellow phosphorus → most reactive allotrope.

→ Flint glass → lead oxide

Bromine → Mother liquor

→ Penicillin operating condition → (25°C, 2atm)

→ Absorption of SO_3 in 97% H_2SO_4
(→ Exothermic process)

Environment Engineering in CE

→ Noise limit (WHO) → 75 db

→ Smog → CO_3, NO_x, SO_2,]

→ Dose of chlorine → 1 $\frac{mg}{lit}$ (ppm)

→ Higher concn of N_2 → Bronchitis

→ CO → (TLV Limit < 50 ppm)
→ Automobiles exhaust, → Asphyxiation

→ Major constituents of air pollution (SO_2)

→ Chloramines ensures → disinfection in water treatment plant

(H^+ ion in distilled water → 10^{-7})

→ Alum → Chemical coagulant.

→ Lagooning process → sludge disposal
→ Temporary hardness removed by → lime-soda process

Composting → Biological decomposition

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pH value of portable water → 6.5 – 8

Chlorination → Remove algae growth.

Catalytic convertor. (Platinum as catalyst)
→ $CO \rightarrow CO_2$
$NO_x \rightarrow N_2, NH_3$

→ Ozone → secondary pollutant
→ Impervious to UV rays.

→ SO_2 → 4 ppm (Pungent smell)

→ Salt content in sea water → 3.5%

→ BOD → characteristic of liquid effluents.

Smoke → ($< 1 \mu m$)

[Smoke + fog → Smog]
→ TLV of mercury in portable water ⇒ 0.001 ppm
Average thickness of Ozone layer → 230 DU

→ Dissolved Oxygen in water ⇒ 5 ppm

→ SO_3 → (not a green house gases)

$\boxed{\text{Mechanical Operations}}$

→ Unit of cake resistance ⇒ Gm/cm^2

→ Shape factor $\propto \dfrac{1}{\text{sphericity}}$

→ For spheres, volume shape factor ⇒ $\dfrac{\pi}{6}\left(= \dfrac{V}{D^3}\right)$

→ Classifiers → Coarse particle from slurry fine particles.

→ Straight line → Incompressible cake and laminar.

Shape factor ⇒ $\dfrac{AD}{V}$ (for spheres)

sphericity ⇒ $\dfrac{\text{Surface area of same volume}}{\text{Surface area of the particle}}$

→ Ultrafine grinders ⇒ Attrition principle

Filter aid is added

→ Added to the feed slurry

→ Precoated to the filter medium prior to filtration

$\sqrt{\left(\dfrac{S}{V}\right)_p}$ TQ ⇒ $3.6\, V W D_t\, \rho$

→ Hot, lumpy and abrasive material → Apron.

→ Screen blinded → Screen is plugged with solid particles

sphericity for Rasching rings ≤ 1

Feed → 100 – 300 mm, Product → 10 – 50 mm (Secondary)

Taggart's ⇒ 93 LS (kg/hr)

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→ Porosity of compressible cake
(Minimum at filter medium)

(Jaw crusher, Ball mill, fluid energy mill)

→ $\phi_s \Rightarrow \frac{6 \cdot V_p}{D_v S_p}$
(Sphericity for non spherical particle)

→ Diatomaceous earth → Most common filter aid

All resistances during washing of cake → Remain constant

Lime stone → Hammer crusher.

Pressure drop ⇒ $\frac{1}{2} \cdot \omega^2 \cdot \rho \, L \, (2k + \delta)$

→ froth floatation → Sulphide ores

Pressure filter thickener → thick suspension from thin slurry

Cassiterite → Not a non-metalliferous mineral

Gravity stamp mill → fine crushing

Hydrocyclone → No gravity settlers operations

Toothed roll → ice and gypsum

Unit of Length (Parsec, Fermi, Angstrom)
(Barn X)

→ $C_4 H_9 OH$ → 74

Stoichometry

→ 1 bar → 1 atm (Bc)

→ Baume gravity scale ⇒ $145 - \frac{145}{G}$
(liquids heavier than water)

$\left[\frac{1\ BTU}{ft^3} = 9\ \frac{kcal}{m^3} \right.$

→ (Be ⇒ $\frac{140}{G} - 130$
(liquids lighter than water)

→ Azetropic solⁿ → "+ve" deviation from Raoult's law

→ Unsteady chemical process
(flow rates and composition both are time dependent)

→ Eutectic point → 3 phases

→ Endothermic reaction → Value of ΔE is > ΔH

P → 2P
Then $V_2 = \frac{V_1}{2}$

→ Boyle's law obey
→ boyle temp.

→ One micron ⇒ 10^{-4} cm

→ Kopp's rule → Heat capacities of solid.

Hess law → Change in heat of reaction

Molal heat capacity at constant volume ≥ 3 kcal/kg mole °K

30.6 mol wt

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Superheated vapor → P.P < E.P.P

→ At 0°k, the molecules have → translational energy

→ Colligative property
- Osmotic pressure
- Depression of freezing point.
- Lowering of vapor pressure

→ depend on constituent of solids

S.T.P → 1atm, 15.5°C.

1% sugar ⇒ 1 brix (Molarity ↓ → T ↑)

→ Saturated pressure → liquid and vapor both exist

→ 20% H_2 in dry basis.
→ Osmotic pressure by 22.41 at 0°C → 1 atm
1kg/m² → 1 mm water column

API gravity of water at NTP → 10

→ kinematic viscosity
↳ $1\frac{m^2}{s}$ ⇒ 10^4 stokes

→ Unit of mass velocity → $\frac{kg}{m^2 \cdot hr}$

→ Neutral solution (pH = 7), the value of $[H^+][OH^-]$
⇒ 1

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Polymer Technology

→ Phenol and formaldehyde condensation → Bakelite
→ Polythene → can be recycled and reutilised

→ Formaldehyde resin → Melamine resins
→ Vinyl flooring → PVC sheets

PVC → emulsion polymerisation (Thermoplastic)
→ Thermosetting polymers → have strongest inter particle forces

Orlon → polymerising vinyl chloride

→ Step growth polymerisation → Terylene

→ Polypropylene → Solution polymerisation

→ Phthalic anhydride → Plasticisers

Polycaprolactum → Nylon-6
→ B-glucose → Monomer of cellulose
Polymers are → Macromolecules

Polythene → Addition polymerisation product

→ Polyvinyl alcohol → water soluble adhesive
→ Melamine → Unbreakable crockery

PMMA (not condensation polymer)

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→ Rain coats are made of → PVC.
→ Rayon is → cellulosic fibre.
→ Phosphates → plasticisers

SBR → Synthetic polymer (Emulsion polymerisation

Nylon 6 (6 represents carbon atom in linear polymer chain)

Liners of bags → Polypropylene

Visco-elastic behavior of plastics → Solid and liquid

→ Zieglers process → high density polymer
→ Vulcanisation of rubber → Thickness decreases

Teflon → Non sticky coating on frying pan

Bakelite, SBR, Buna-S → Copolymer

Tyres → Rotational moulding

Thermoplastic resins → less brittle than thermosetting plastic.

→ Thermosetting materials → cross linked molecules
→ Plastic tubes and pipes → Extrusion
Vulcanite or ebonite → no elasticity