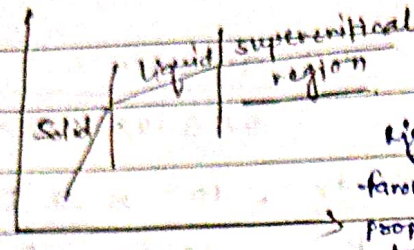
Super critical fluid (SCF) extraction :—



critical condn :— Liqd. & vapour phase are not distinguished

properties of fluid under supercritical conditions :—

highly favour prop. to dissolve target molecule

(i) liquid like density
(ii) Reduction in surface tension
(iii) Gas like viscosity
(iv) Diffusivities higher than liquid
(v) Gas like compressibility.

Common super critical fluids :—

CO_2, Ethylene, Propylene, ethanol.

Substance	T_c (K)	P_c (atm)	Density (g/cc)
CO_2	304	73	0.47
Ethane	305	48	0.2
Ethanol	516	63	0.3
Propane	370	42	0.22

CO_2 is common SCF :—

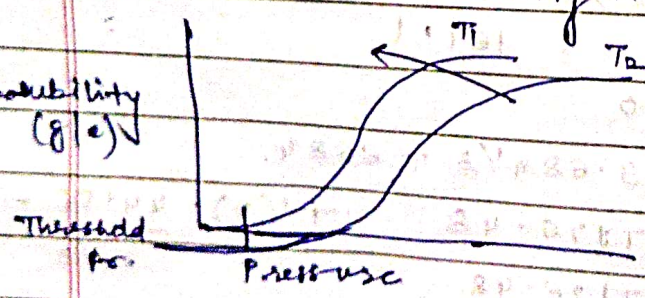
(i) low P_c and low T_c
(ii) Non Toxic
(iii) Non-flammable
(iv) Available in high purity
(v) low cost

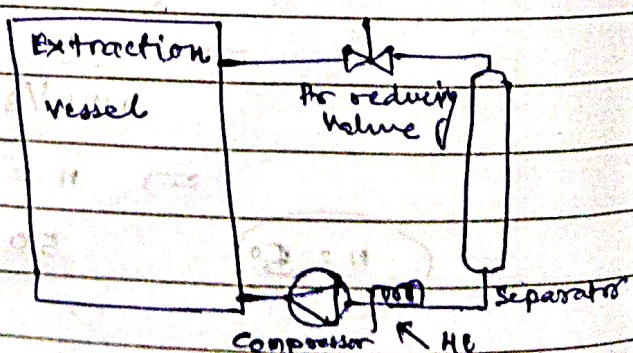
Disadv. :— Extrac^n of polar compounds is difficult ~~in case of~~
→ Co-solvents / modifiers is used.
CO_2 is mixed with 1% — 10% methanol

H_2O Disadv : (i) $T_c > 374°C$
$P_c > 221$ bar
(ii) Under SC condition water becomes corrosive

Working principle :—

based on solute solubility in SCF





→ removal of fat from foods
→ Vit E extraction from natural sources
→ removal of alcohol from wine / beer

Electrophoretic Separation Process :—

colloidal / macro molecules (nm) — Charged properties of solutes | proteins | micelles | Pectin

Applications in pharmaceutical ~~[illegible]~~ & bio medical

Isoelectric pH :

Compounds	PI (25°C)
Aspartic Acid	2.77
Lysine	9.74
Oval bumin	4.7
BSA	4.95

Myoglobin — 7.33

Cyto chrome C → 9.28

If $KR_p < 0.1 \Rightarrow u = \frac{2}{3}\frac{\epsilon_0 \epsilon \xi}{\mu}$

$> 0.1 \rightarrow u = \frac{\epsilon_0 \epsilon \xi}{\mu}$

($u = \frac{v_e}{E}$)

complications of electrophores

Typical mobility :—

$10^{-8}\ \frac{m^2}{V.s}$ → ions $10^{-9} \rightarrow \frac{m^2}{V.s}$ → Proteins

Joule heating (i^2RT)

- T↑ Proteins may be denatured
- mixing & sep^n is difficult
- May lead to natural convection

Methods to avoid convection

(i) Adopt an efficient cooling method

(ii) To maintain 4°C in the cell.

(iii) Height of the electrophoretic cell is kept small

(iv) Porous gel is introduced

(B) Electroosmosis [should be avoided]

Coating of wall surface by materials like : methyl cellulose

Gel — electrophoresis

gel → 1) Inert (should not react with species)

2) No residual charge on the gel material.

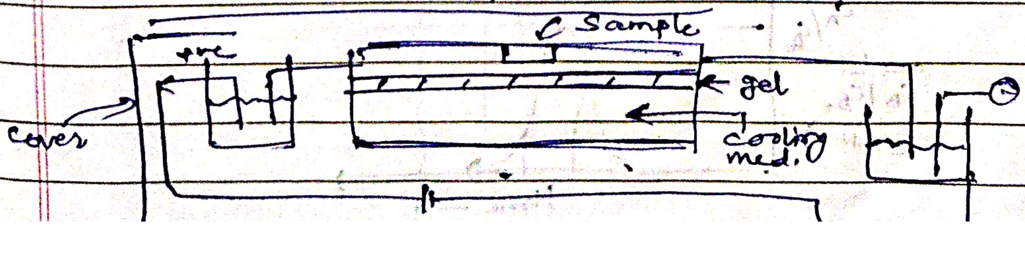
3) Gel pore size much higher than size of macromolecule.

Typical gel material — Polyacrylamide gel assisted electrophoresis

Advantages :— (i) Excellent anti-convective

(ii) can polymerise on glass surface

Schematic of electrophoretic cell :—



7/04/

Novel Seperⁿ Process

Chromatographic Seperⁿ Processes :—

Principle : Based on residence time of a solute in the column.
→ Residence time is different for different solutes due to different extents of transport

Features :—

* High pressure pump is needed to inject liq. sample
* A pulse of sample is injected.
* Column is enclosed to maintain temperature
* Detector (UV | RI) detects the solutes at elutant
* Conc is measured by absorbance value.

Typ. Op. condition :—

feed conc : 1 mg/l
Col. dimension : 10 cm × 4.6 mm
Packing : Weak cation exchange beads
Pore size of solid matts ~ 300 Å
Typical flow rate : 1.5 ml/min.
Volume of injection : 10 µL

Gas Sys. :— carrier gas is He
Adsorbent is used → Alumina, zeolite
Gas – liq. chromatograph (GLC)
Inert, porous solid beads are coated with viscous high boiling liq.
1.) should be selected so that it does not create contamination. ← stationary phase causes seperⁿ
2.) Evaporation of liq. should be very slow

Liq. Liq. chromatography (LLC) :—

* A stationary liq. phase is coated on the inert porous solid beads
* Seperⁿ is based on extract

High ps. liquid chromatography (HPLC) :—

* Solids Silica
* Stationary liq HCs C8 or C18 compound
* ΔP ~ 1000 psi

Size exclusion chromatography (SEC)

No Adsorp^n / Diff^n, Sep^n is purely by size exclusion, Larger size solutes are seperated from smaller ones.

Solid matrix :— Gel, Sephadex, Agarose

Solute movement through the Col. :—

ϵ_e = Avg. Interparticle porosity = $\frac{\text{Vol. b/w particles}}{\text{Total Vol. of packed bed}}$

ϵ_p = Avg. intraparticle porosity = $\frac{\text{Vol. inside particles}}{\text{Total vol. of all particles}}$

Total bed porosity = ϵ_T = Sum of voids within & b/w particles

$= \epsilon_e + (1 - \epsilon_e)\epsilon_p$

Bulk density : $\rho_B = (1-\epsilon_e)\rho_p + \epsilon_e \rho_f$

ρ_p → particle density

ρ_f → fluid density

$\rho_p = (1 - \epsilon_p)\rho_s + \epsilon_p \rho_f$ ρ_s → crystalline density of solid after crushing

Pores are not uniform in size → size distribution

Larger particles are sterically hindered

K_d = fraction of vol. of pores that a molecule can penetrate

$= \frac{V_e - V_o}{V_i}$ V_e → elution vol. V_o → ext. void vol. b/w particle

V_i → Internal Void vol. within.

for small particles :—

$V_e = V_i + V_o$ $K_d = 1.0$

Physical processes involved in solute transport :—

(i) Solute diffuses through external liqd. film to particles

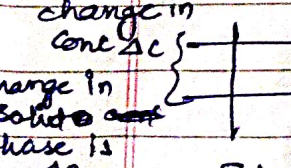
(ii) Solute reaching the surf can be adsorbed on ext. surf. or can diffu

(iii) through liq. filled in pores. There may be surf. diffusion as well

(iv) Solute finds an active site & gets adsorbed.

(v) Solute desorbs.

vel. of solute = $f(\epsilon_e, \epsilon_p, K_d, \text{Sorption Equal})$



Ext. void vol. = $\epsilon_e A_c \Delta z$ Area of CS

Internal void vol. = $(1-\epsilon_e)\epsilon_p A_c \Delta z$

Solute in bed can be (i) In the mobile fluid in ext. vol.

(ii) in stagnant liq. inside particle (iii) Adsorbed state on the particle