[Seperation of Lanthanoide element]

All Ln^{+3} oxidn state
La to Lu ⇒ (Similar size) (atomic radii)
Seperation is most difficult

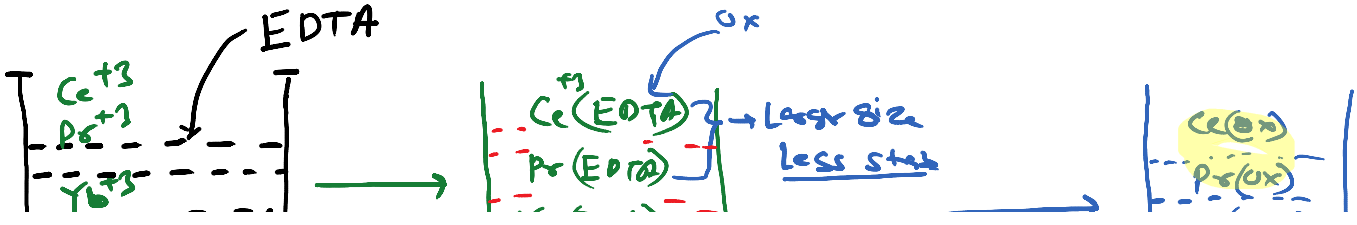
(I) Complex formation
(II) Solvent Extraction Methods
(III) Ion. Exchange Method (Colum Chromatography)
(IV) Valency change Methods

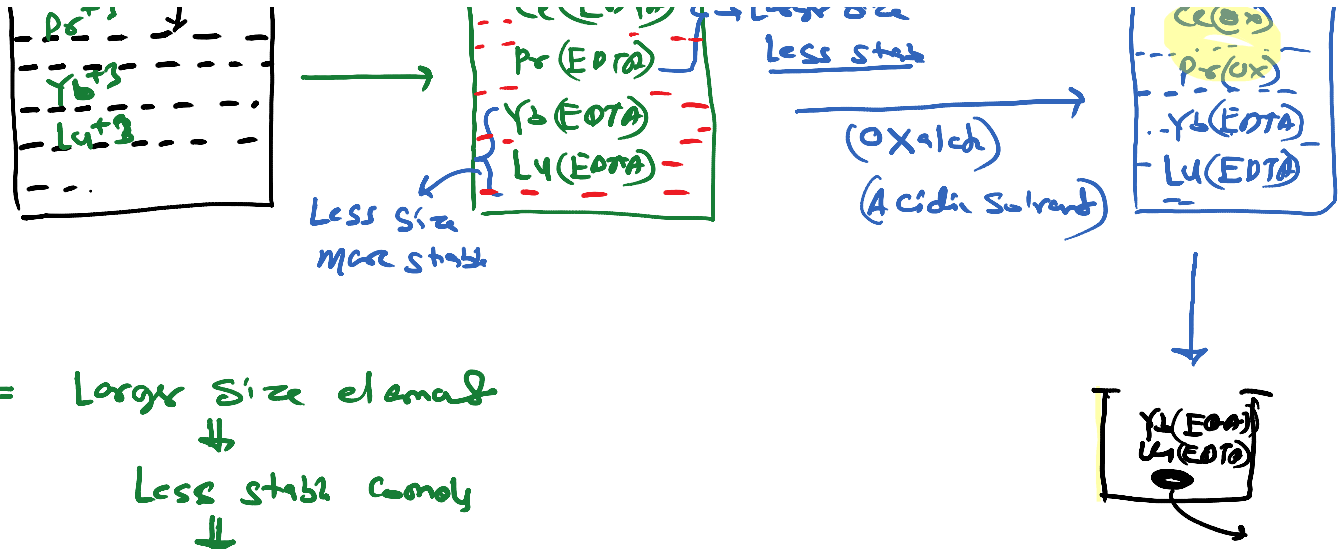
Complex formation :⇒
Ligand must be π-acceptor & π-donor
Ex EDTA , Oxalate,

Ln^{+3}

[Heavier element]
[High atomic No]
Lu^{+3}, Yb^{+3}
$[Lu^{+3}]$
⇓
Smaller size
⇓
[more attraction]
⇓
[more Dissociation Energy]
⇓
(More stable)

[lighter element]
[low-atomic No]
La^{+3}, Ce^{+3}
La^{+3}
⇓
Larger size
⇓
Less attraction
⇓
Less Dissociation Energy
⇓
[Less stable]





Larger size element
⇓
Less stable complex
⇓
[Less Dissociation]
⇓
(Ppt)

* Which elements form more stable complex ⇒

(A) Nd^{+3} (B) Ho^{+3} ~~(C)~~ Yb^{+3} (D) Pr^{+3}

[Less size element form more stable complex]

Charge Concept ⇒ If +ve charge on complex ↑ Complex formation ability ↑

M^{+4} > M^{+3} > M^{+2}

(M^{+4}): (Smaller size) ⇓ (more Zeff)

(M^{+2}): (Larger size) ⇓ (Less Zeff)

#02 Solvent Extraction Method ⇒

It depend on partition coeffient ⇒
partition coeffient is the solubility of solute in organic medium divided by solubility of solute in aq. Medium

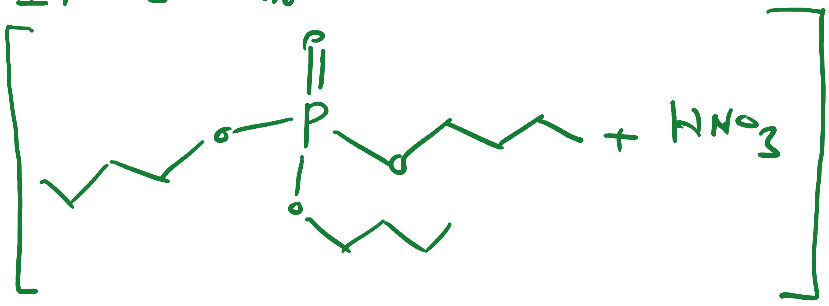
$$P.C = \frac{\text{Solute in organic Medium}}{\text{Solute in aq Medium}}$$

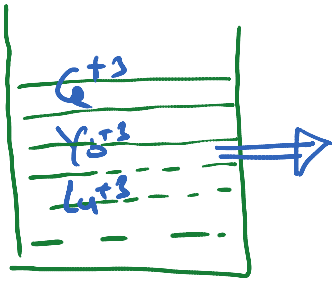
$$P.C = \frac{\text{Solubility in organic medium}}{\text{Solubility in aq Medium}}$$

$$PC = KP = \frac{[\text{Solute}]_{org}}{[\text{Solute}]_{aq}}$$

[
Smaller size element ka more P.C
Larger size element is less P.C
]

In Solvent :- Solvent used



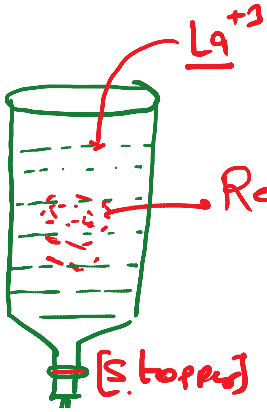


[Lu^{+3} ⇒ Smaller Size]
⇓
[More P.C]
⇓
[More Solubility]

Which of the following Ln^{+3} element is more P.C ?

(A) Nd^{+3} (B) Pr^{+3} (C) Tb^{+3} (D) Yb^{+3}

#02 :- Ion Exchange Chromatography :-
[Colum Chromatography]



[Smaller size]

↓

Ln^{+3}

↓

More solvated in H_2O

↓

More attraction

↓

Complex formed

↓

[Fast eluted]

[Larger size]

↓

Ln^{+3}

↓

Less solvated in H_2O

↓

(Less attraction)

↓

Slow complex formed

↓

[Slow eluted]

arranged the 4 ords of Ion. Exchg of Ln^{+3}

Ce^{+3}, Pr^{+3}, Nd^{+3}, Tm^{+3} Yb^{+3}, Ln^{+3}

(I) $\underbrace{Ln^{+3}}_{\text{(Small size)}} > Yb^{+3} > Tm^{+3} > Nd^{+3} > Pr^{+3} > \underbrace{Ce^{+3}}_{\text{(Larger size)}}$

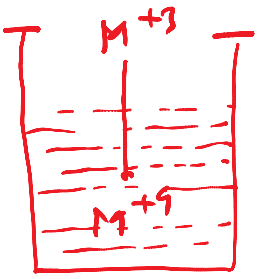
#04 Valency Exchange Method :⇒ Solvent ⇒ (Alkalin solvent)

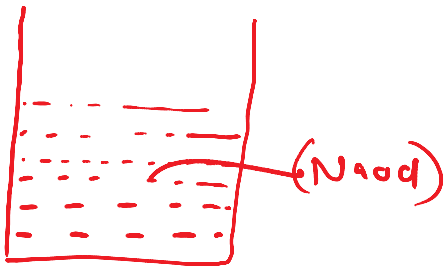
Generally used for Ce^{+4}, Eu^{+2}

$$\underset{\text{(Oxidizing agent)}}{Ce^{+4}} \xrightarrow[\text{Red}^n]{\text{gain of } e^{\ominus}} Ce^{+3} \qquad [Ce(NO_3)_6]^{-2}$$

$$\underset{\text{(Reducing agent)}}{Eu^{+2}} \xrightarrow[\text{oxid}^n]{\text{loss of } e^{\ominus}} Eu^{+3} \qquad [Eu(SO_4)]$$

T M^{+3} T





$Ce^{+3} \longrightarrow Ce^{+4}$

$f^{1} \qquad f^{0}$

(Colorless) (Colorless)

$f^{0}\ Ce^{+4} \xrightarrow{Red^{n}} Ce^{+3}$

(Oxidising agent) f^{1}

$Ce^{+3}\ [Xe]\ 4f^{1}\ 5d^{0}\ 6s^{0} \xrightarrow{(\Delta l = \pm 1)} 4f^{0}\ 5d^{1}\ 6s^{0}$

$l=3 \quad l=2$

$(\Delta l = \pm 1)$

Valency Exchange Method ⇒

$Eu^{+2} \quad Ce^{+4}$

$Eu^{+3} \quad Ce^{+3}$

Thank you