7. Debye-Huckel limiting law

1 Review

→ Reference electrode (CE, WE, RE)

2 Ion-Ion Interaction & activity

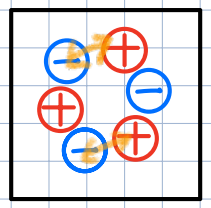
→ Activity : 특정성분의 양(농도, 몰농도) & 그 성분의 종류(분자끼리의 상호작용)에 영향을 받는다, 이론물질의 "이(탈)상"

↳ $a_i = \gamma_i C_i$ (activity coefficient : $\gamma_i = \frac{a_i}{c_i}$)

↳ 순수한 물질일때 (혼합물 X) $\gamma = 1$, but 혼합된 수록 (이온일 수록) $\gamma < 1$

↳ Why? : 분자끼리의 상호작용 & Ion-Solvent 상호작용

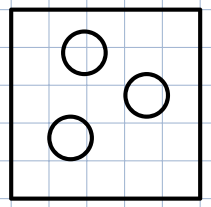
→



[Ion-Ion Interaction O]

$\mu = \mu_j^0 + RT\ln a_j$

$= \mu_j^0 + RT\ln c_j + RT\ln \gamma_j$ → 농도나 전하수록 (c ↑) 감소 (↓) → stabilized (Gibbs free E ↓)

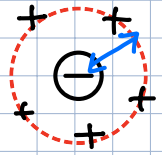


[NO ion-Ion Interaction]

$\mu = \mu_j^0 + RT\ln a_j$

$= \mu_j^0 + RT\ln c_j + RT\ln \gamma_j$ → $= 0$ → less stabilized (Gibbs free E ↑)

→ Ionic strength : $I = \frac{1}{2}\sum_j c_j z_j^2$ & Debye length $\propto \frac{1}{\sqrt{I}}$



→ Ionic concentration = Ionic strength ↑

= Stabilization ↑

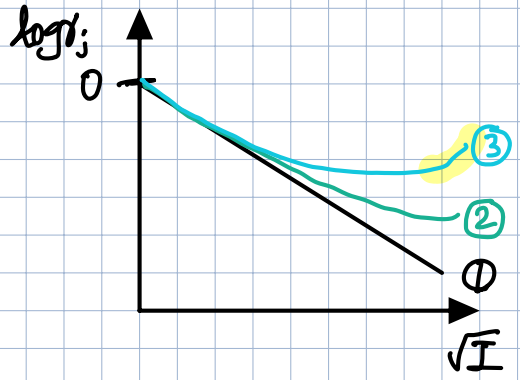
= Debye length ↓

= γ ↓

③ Debye - Huckel limiting law

→ Ionic strength (이온 강도) : 전체 이온들의 농도를 반영으로!

→ $\log\gamma_j$



① Debye-Huckel limiting law (DHL) : $\log\gamma_j = -Az_j^2\sqrt{I}$

↳ $< 10^{-2}$ M & point charge (real: hydration & point charge X)

② Extended Debye-Huckel limiting law (EDHL) : $\log\gamma_j = \frac{-Az_j^2\sqrt{I}}{1+Ba\sqrt{I}}$

↳ only consider "Ion-Ion interaction"

③ Robison - Stokes (R-S) : $\log\gamma_j = \frac{-Az_j^2\sqrt{I}}{1+Ba\sqrt{I}} + cI$

↳ Ion-dipole interaction (즉, Ion-solvent interaction)

↳ 염도 늘어나면 water 분자 줄어들고, 즉 stabilize되는 분자 줄어들고, ∴ γ 가 증가