Rabibrata

LEACHING

Mass Tr - II

Chapter 13/ TREYBAL

Set - 6 6 1

Leaching is a preferential solution of one or more Constituents of a solid mixture by contact with a liquid solvent.

Leaching. Originally referred to percolation of the liquid through a fixed bed of solids.

Lixivation is a less frequently used. synonym of Leaching.

↳ It originally referred to leaching of alkali from wood ashes.

Decoction : It is a special case of leaching when. where the solvent is at boiling temperature.

Elutriation or Elution:- When the soluble material. is largely on the surface of an insoluble solid and. is merely washed off by the solvent.

Leaching is most Extensively used in the Metallaurgical Industry.

Many other chemicals also are separated by leaching: examples include sugar from sugar beat ~~by~~ by leaching with hot water, vegetable oil from seeds. like soyabean and cottonsead with organic solvent.

* Tea and Coffee are prepared by leaching.

* Often the solid has to be given a pre-treatment- Crushing and grinding are preferred in this regard, that enhances leaching. This is a preferred. route in metallaurgical industry.

* For extraction of product from vegetable and animal bodies, which are cellular in str. The product to be leached in most cases remains with in the cell walls. Which is to be leached out of the cell wall- Thus leaching involves osmotic passage thru the cell wall. It is however Not desirable to crush everything, as that would bring undesirable albumin and. colloids to the product.

Thus for extracting sugar from beat, The sugar beets are cut into small wedge-shaped slices Called cossettes. This reduces the diffusion path.

Leaching Temperature.

It is generally desirable to do a leaching at as high temperature as possible, as at higher temperature the solubility is maximum. Also, at higher temperature, the viscosity is lower and. diffusivity is higher.

Solution Mining:- In Place (in situ) Leaching.

This refers to percolation. leaching of minerals In place at the time, by the circulation of Solvent, over and thru' the ore body.

Calculation:-

It is for estimating the extent of leeching which can be obtained for a given procedure, that is to calculate the amount of soluble substance leached from a solid, knowing the initial solute content of the solid.

Stage Efficiency

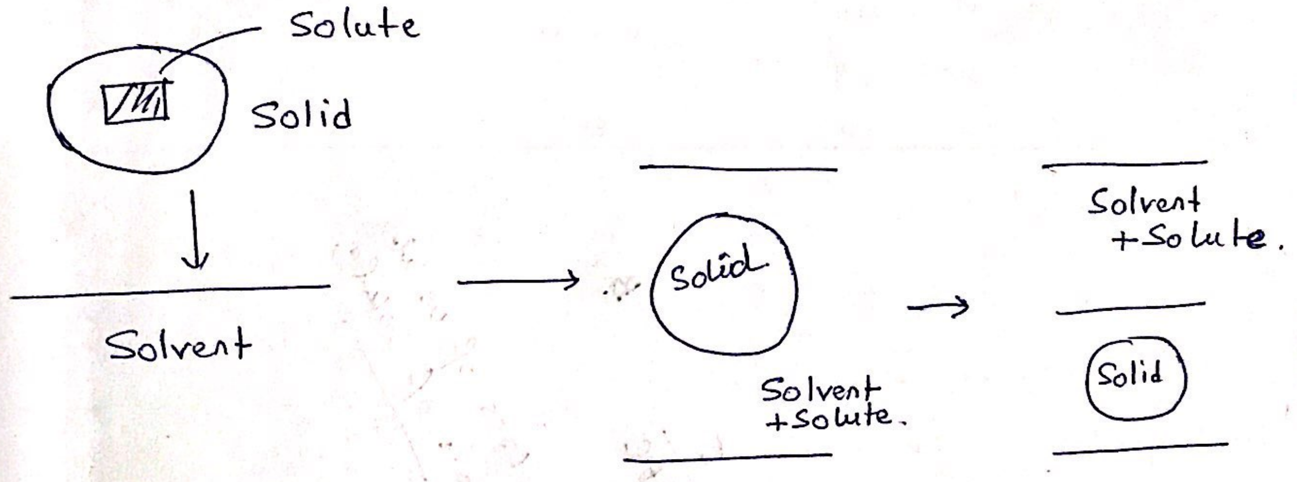
Solid is leached with more than enough solvent to dissolve all the soluble solute present. If further there is no preferential adsorbtion of either solvent or solute by the solid.

If adequate time of contact of solid and solvent is permited, then all the solute will dissolve in the solvent.

The ~~two~~ insoluble solid is then separated from the liquid, ~~by~~ physically drainage, / settling / filtration etc. The entire operation constitutes one stage, This would be an eqlbm. stage with 100% stage efficiency.

In practice, stage efficiencies are much less than this, because (1) the solute may not be completely dissolved, due to inadequate contact time, (2) The liq solid mech sepn with 100% efficiency is impractical, and solid leaving the stage ~~in~~ will always retain some liquid and its associated dissolved solute.

In case solute is adsorbed ~~on liquid~~ ~~by~~ on the solid, even though equilibrium between the liq and solid phase is obtained, imperfect settling or drainage will result in lower efficiency.

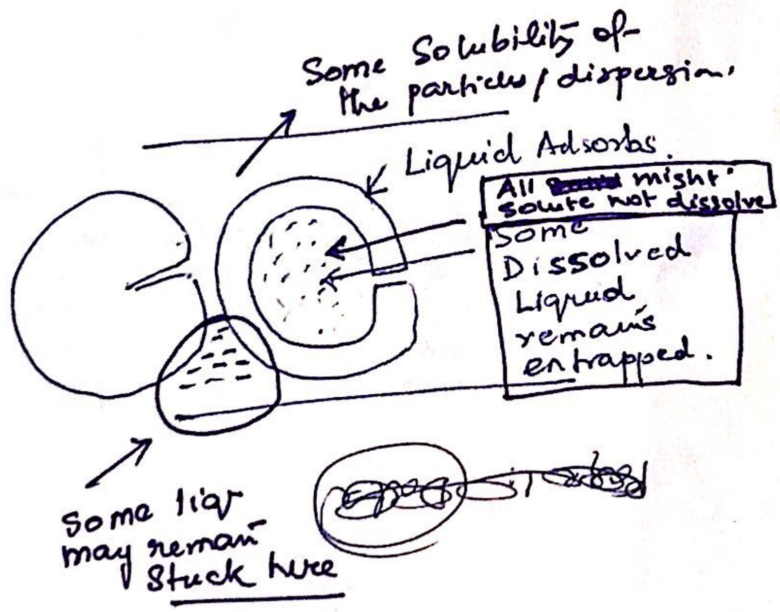


Inefficiency can be due to

1. Solute ~~at~~ adhering on to the solid.
2. Solution might be entrapped. in the solid.
3. Some solid might be dissolved in the solvent. /dispersed (Brownian motion, if solid particles too small),
4. All the solute might not dissolve from the solid. to the solvent.

Time requirement is also an important factor.

Some liquid can
(1) Remain stuck inside the pores,
(2) Outside between the particles,
(3) Adsorb on the surface of the particles,



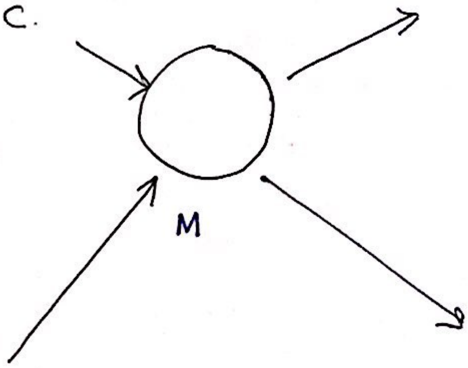
Solid to be Leached

B, Mass of insoluble.

F, Mass of A + C.

$$N_F = \frac{B}{A+C}.$$

$$y_F = \frac{C}{A+C}$$



Leached Solid (E_1)

B, Mass of Insoluble.

E_1 = mass of (A + C)

$$N_1 = \frac{B}{E_1} = \frac{B}{(A+C)_{E_1}}$$

$$y_1 = \frac{C \text{ in } E_1}{(A+C)_{E_1}} = \frac{C \text{ in } E_1}{E_1}$$

Leaching Solvent

R_o, mass of Soln. (A + C)

$$x_o = \frac{C}{A+C}$$

$$N_o \simeq 0$$

Leached Solution (R)

R_1 = Mass of Soln.

$$x_1 = \frac{\text{mass of C}}{\text{mass of } (A+C)}$$

In leaching,

A → Solvent
B → Insoluble.
C → Solute

*

In Case the ~~Solution~~ no adsorbtion of Solute occurs and, so that the withdrawn ~~solid~~, solution and solution associated with the solid, have same composition, and the tie lines becomes vertical,

The ~~equib~~ equilibrium curve is a 45° line and distribution coefficient is 1.

For a feed that is dry,

N = Ratio of Insoluble to soluble Substance $= \frac{B}{C}$

And $y_F = 1{\cdot}0$. $\langle y_F = \frac{C}{A+C}$, If dry $A = 0 \rangle$

And for a pure Solvent (pure A)

$N = 0$

$x = 0$

Concept of Practical Equilibrium

Solid to be Leached.

B, Mass of Insoluble

F, Mass of A+C.

$N_F = \frac{B}{A+C}$, $y_F = \frac{C}{A+C}$

Leaching Solvent

R_0 = Mass of Soln. (A+C),

$x_0 = \frac{C}{A+C}$.

$N_0 \simeq 0$.

Leached Solution. (R)

R_1 = mass of Soln.

$x_1 = \frac{\text{mass of } C}{\text{mass of } (A+C)}$

N_{R1}

Leached Solid.

B, Mass of Insoluble.

E_1, mass of A+C

$N_1 = \frac{B}{E_1} = \frac{B}{(A+C)_{E_1}}$

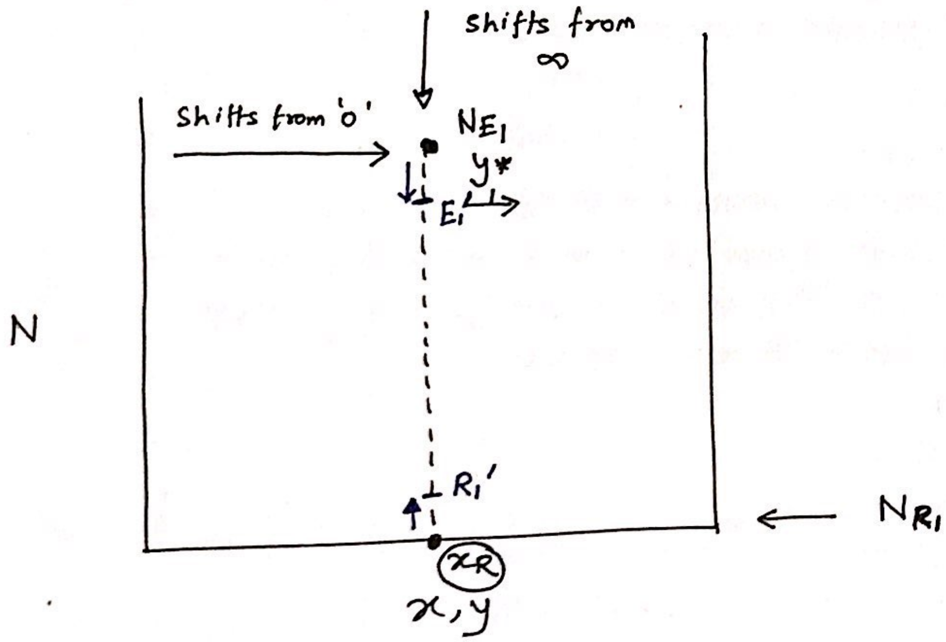
$y_1 = \frac{C_{\text{in } E_1}}{(A+C)_{E_1}} = \frac{C_{\text{in } E}}{E_1}$

① We have a ~~sol~~ liquid. whose composition B, should be ideally zero. ~~as dos~~

A = Solvent

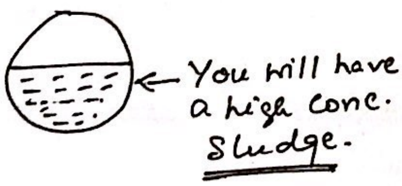
C = Solute

B = Insoluble.

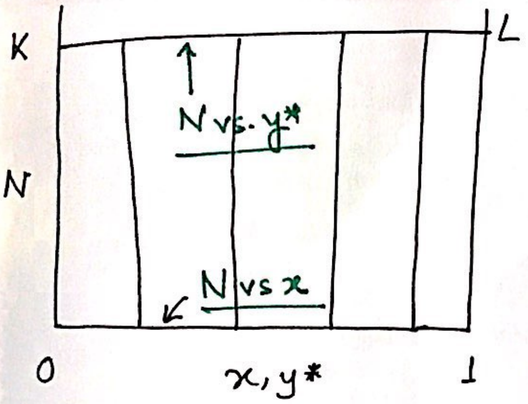


For the Leached Solid → N_{E_1} or N_1 = ? (Ideally ∞).

Practical Reality is



Some typical Equilibrium Plots,

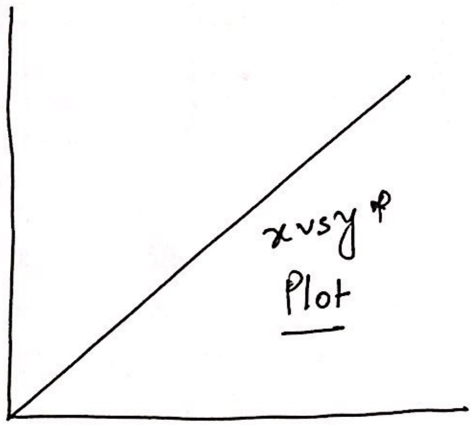


Vertical tie line.

Here

(1) No adsorbtion of ~~s~~ any. Solvent on the Leached Solid.

(2) No dispersion of any. Solid in the leached. ~~solved~~ solution.



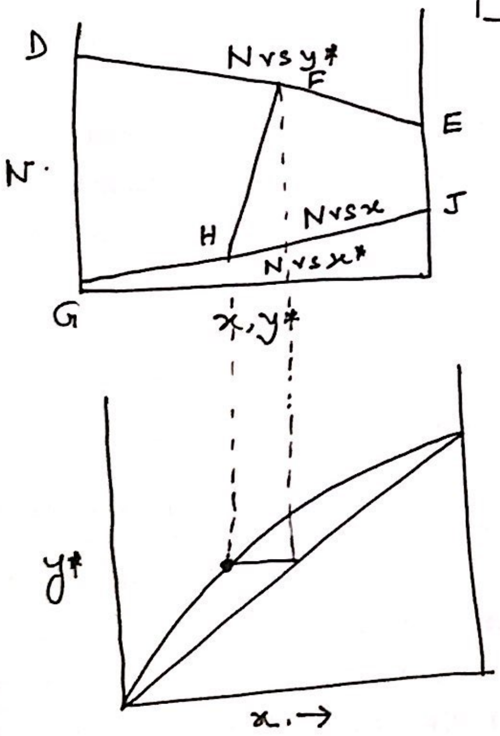
The graph indicates that the Solids are settled or drained. ~~at~~ to the same extent at all solute Concentration.

This situation is referred to as constant overflow situation.

For both cases the solute has solubility in the solvent for all. fractions

C is infinitely soluble in A

(2)



* The line GHJ, which ~~is the~~ provides the composition of the withdrawn solution, lies above N=0, ~~indi~~. which is possible only when either solid B has. limited solubility in the Leached solution or, incompletely settled liquid. has been withdrawn.

The tie lines are not vertical.

(1) Insufficient time of contact for the leaching solvent to dissolve all solute.

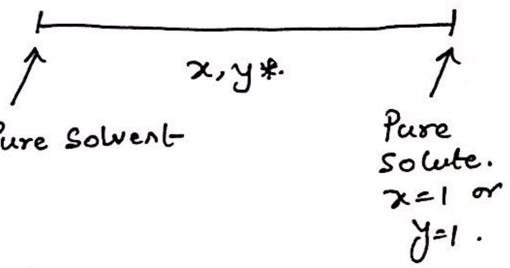
(2) Preferential adsorbtion of the solute.

(3) Solute is soluble in the Solid B and distributes unequally into the solid and liquid phases at equilibrium.

Scanned with CamScanner

There was a major assumption in both the previous plots,

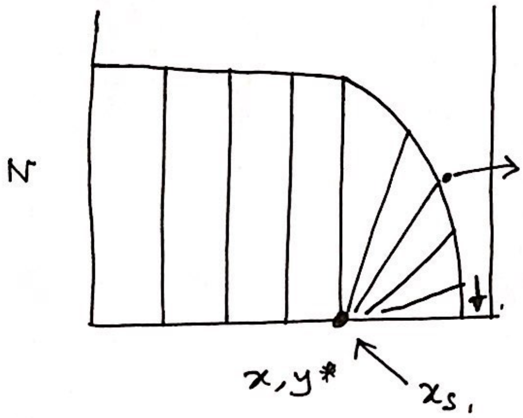
The assumption was that the solute has complete solubility for all values of solvent concentration!



* This will hardly happen.

* So, what is a more likely situation.

There will be a limiting solubility of the solute



Why does slurry conc. start reducing below B

$$N = \frac{B}{A+C}.$$

C. concentration increase.

So in this case, no clear solution stronger than x_s is possible.