

# Leaching Equipment

# *Leaching*

- ***Leaching* is a solid-liquid operation.**
- The two phases are in intimate contact, the solute(s) can diffuse from the solid to the liquid phase, which causes a separation of the components originally in the solid.
- A special leaching process, when an undesirable component is removed from a solid with water, is called *washing*.

# *Leaching*

## *Applications:*

- It is used in the **biological and food processing** industries
- Ex: the separation of sugar from sugar beets with hot water, the extraction of oils from peanuts, soybeans, sunflower seeds, cotton seeds.
- In **pharmaceutical industry**, many products are obtained by leaching **plant roots, leaves, and stems**.
- In the **metals processing industry**, leaching is used to remove the **metals from their ores**, which contains many undesirable constituents, as solute salts.
- Ex: gold leaching, gold is leached from its ore using an aqueous **sodium cyanide solution**.

# *Principles of Leaching*

- The solvent must be transferred from the **bulk solvent solution** to the surface of the solids.
- Next, the solvent must **penetrate or diffuse** into the solids.
- The solute then diffuses through the solid solvent mixture to the surface of the particle.
- Finally, the solute is transferred to the bulk solution.
- The **rate of the solvent transfer from the bulk solution** to the solid surface is quite **rapid**.
- However, the **rate of transfer of the solvent into the solid** can be rather **slow or rapid**.
- This solvent transfer usually occurs initially when the particle are first contacted with the solvent.

# *Principles of Leaching*

- The **rate of diffusion** of the **solute through the solid and solvent to the surface of the solid** is often the **controlling resistance** in the overall leaching process and can depend on a number of different factors.
- If the solid is made of **porous** the diffusion through the porous solid can be described by an **effective diffusivity**.
- The **resistance to mass transfer** to the solute from the solid surface to the bulk solvent is generally quite **small** compared to the resistance to the diffusion within the solid itself.

# *Types of Leaching*

- **Unsteady state operations**
  - In Situ (In-Place) Leaching
  - Heap Leaching
  - Percolation Tanks
  - Shanks System
  - Filter press leaching
  - Agitated vessels
- **Steady state (Continuous) operations**
  - Agitated Vessels
  - Thickeners
  - Continuous Countercurrent Decantation (CCD)
  - Hydrocyclones
  - Filter leaching

# *Unsteady State Leaching*

## **In Situ (In-Place) Leaching:**

- Also called as **solution mining**.
- The percolation leaching of minerals in place at the mine, by circulation of solvent over the ore.
- **Removal of salts** from deposits below earth surface by the solution of salt water which pumped into the deposit.
- Example: **Leaching of Low-grade copper ores, uranium ores.**

# *Unsteady State Leaching*

## **Heap Leaching:**

- Low-grade ores whose minerals values do not warrant the expense of crushing or grinding can be leached in the form of run of mine lumps into huge piles.
- **Examples: Copper from pyritic ores, uranium.**



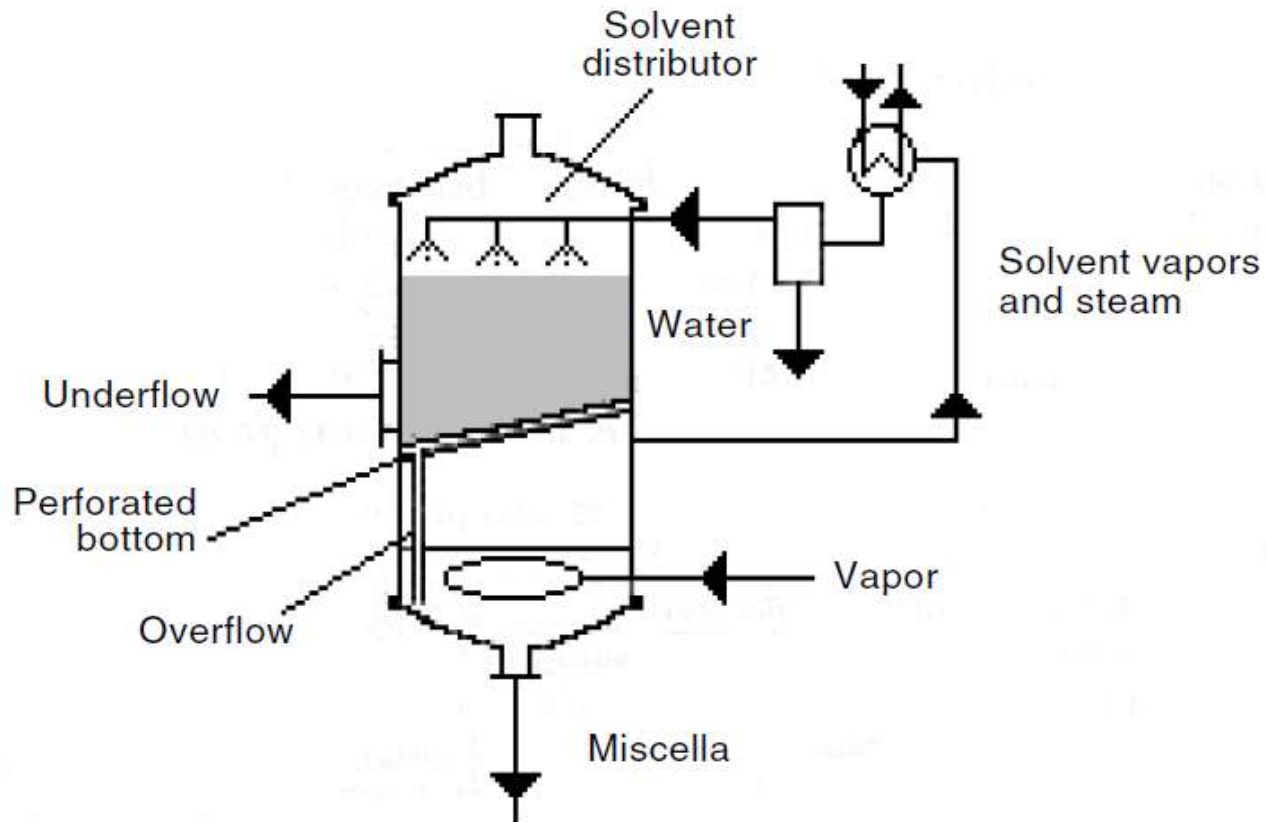
# *Unsteady State Leaching*

## **Percolation tank Leaching:**

- When the pressure drop for flow of liquid is too high for gravity flow, closed vessels must be used. (Diffusers)
- Closed tanks are necessary to prevent evaporation losses when the solvent is volatile.
- **Examples: Sugar from sugar-beet slices.**

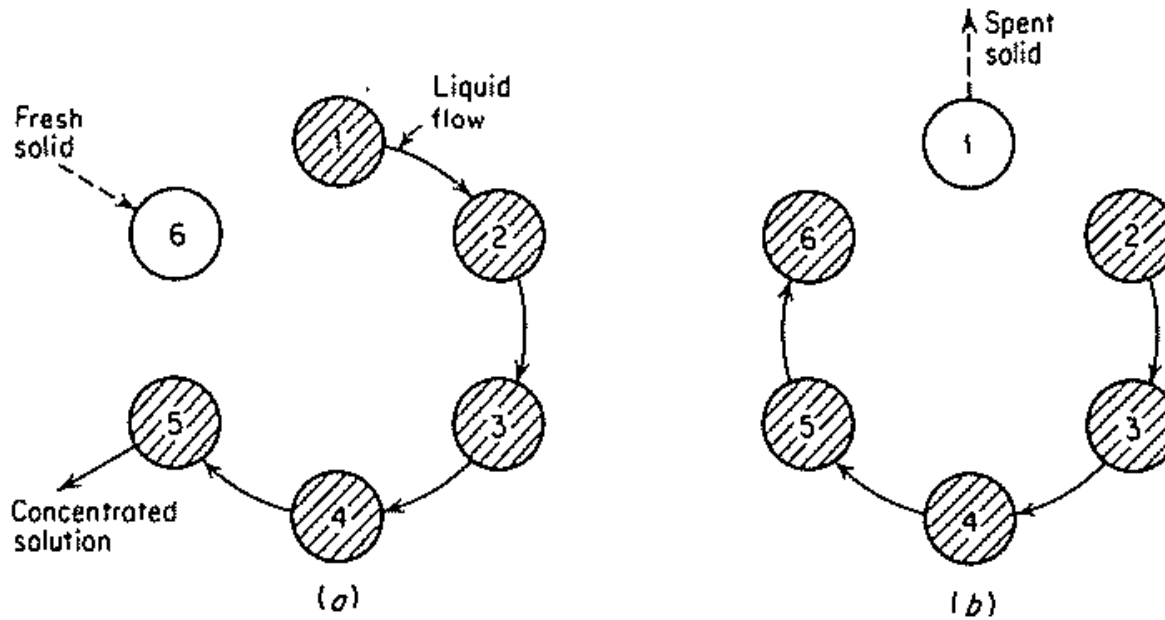
# *Unsteady State Leaching*

## Percolation tank Leaching:



# *Unsteady State Leaching*

**Shanks system:**



# *Unsteady State Leaching*

## **Shanks system (Extraction Battery):**

- ✓ Used in Metallurgical industries.
- ✓ Recovery of tannins from tree barks and woods.
- ✓ Leaching of Sodium-nitrate from Chilean-nitrate bearing rock.

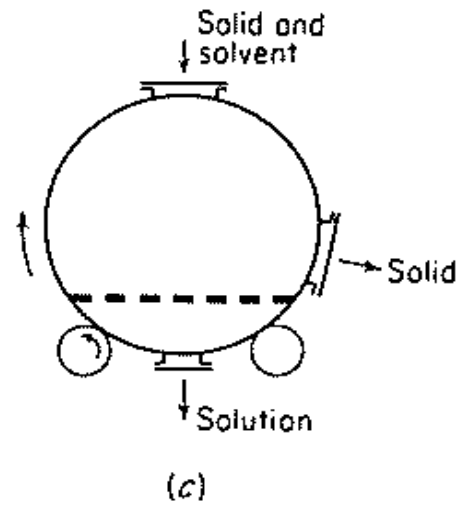
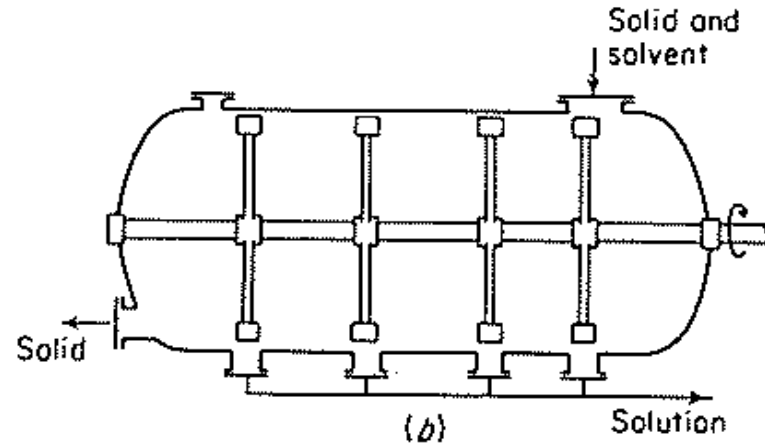
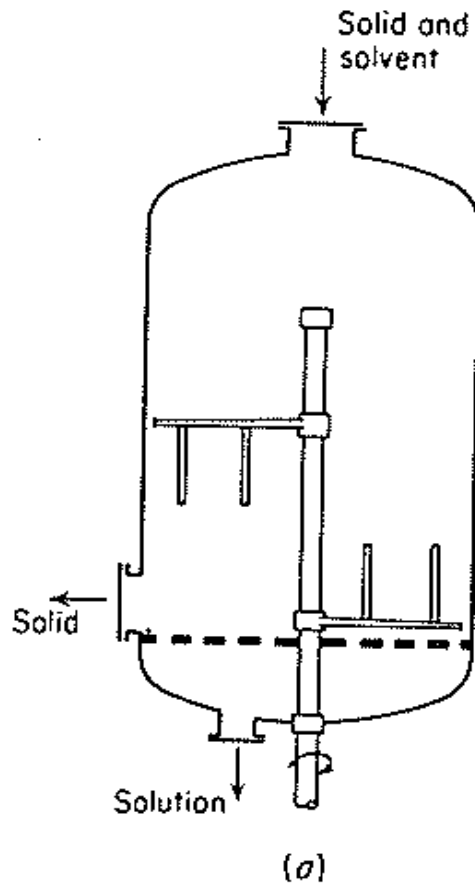
# *Unsteady State Leaching*

## **Agitated Vessels:**

- Used for coarse solids.
- Closed cylindrical vessels containing paddles or stirrers on vertical shafts, as well as false bottoms for leach solution removal.
- Finely divided solids can be suspended in leaching solvents by agitation.
- Example: Metallurgical industries.

# *Unsteady State Leaching*

## Agitated Vessels:

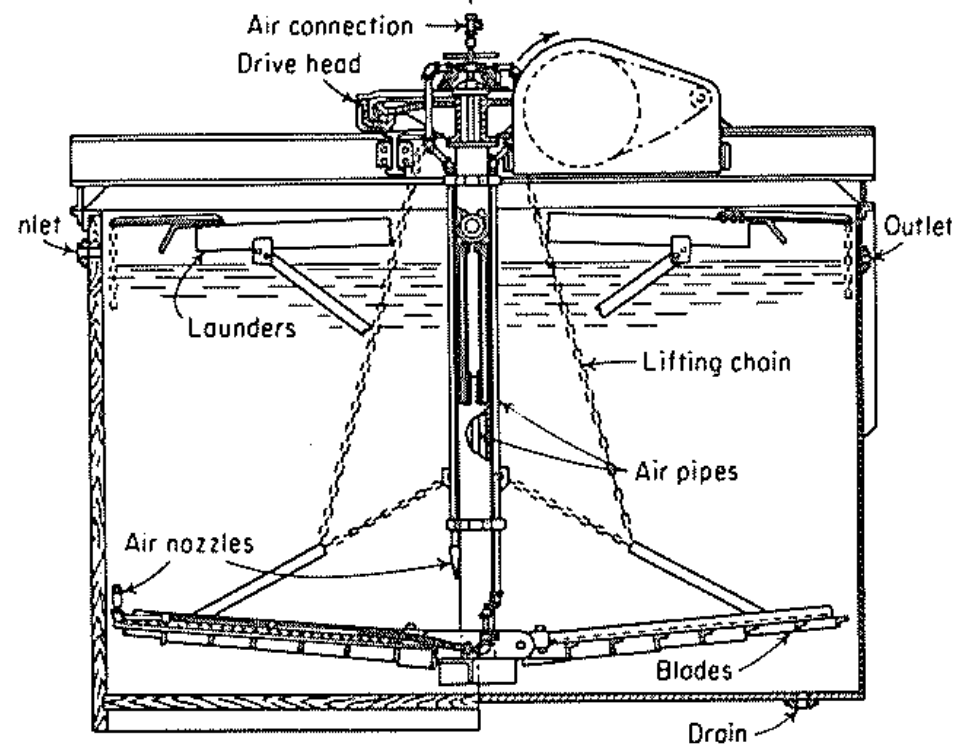
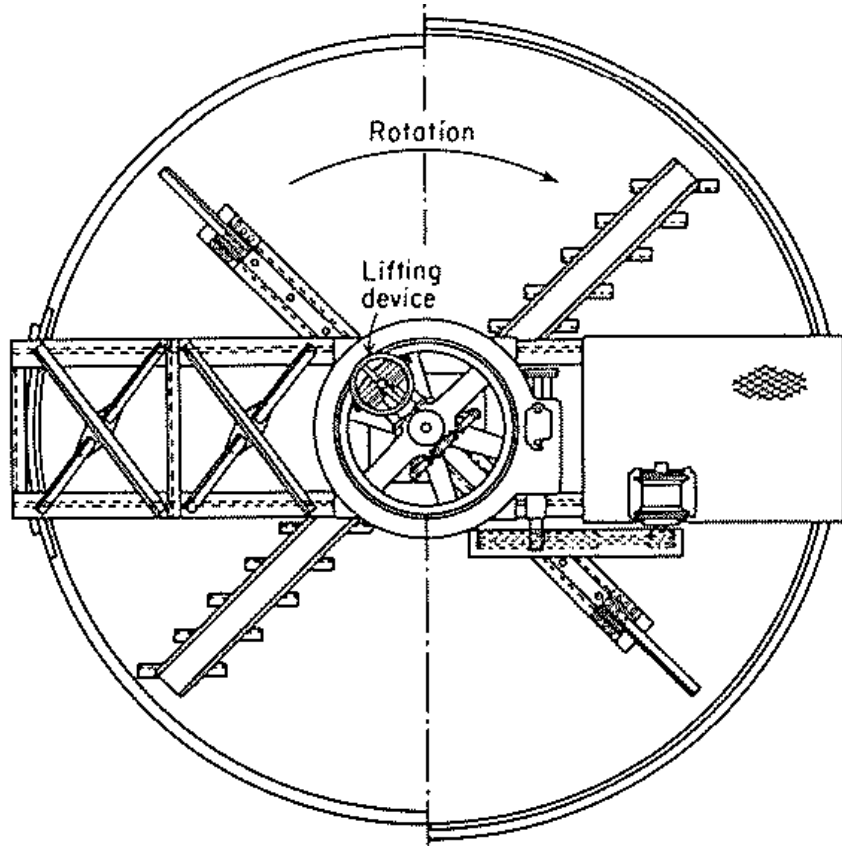


# *Steady State Leaching*

## **Agitated Vessels:**

- Finely **ground solids** can be readily **suspended in liquids by agitation** be continuously leached in any type of agitated tanks or vessels.
- There is a continuous flow of liquid and solid into and out of the tank, so that **no accumulation of solid** occurs.
- Turbine type agitator is used for effective operations.
- **Types: Pachuca tanks and Dorr agitators** (air-lift and mechanical principle).
- Central shaft acts as an air lift and revolves slowly.
- Arms attached to the shaft bottom moves the settled solids towards the center, where they lifted by air through the shaft to the revolving launders attached to the top.

# *Steady State Leaching (Agitated Vessels)*





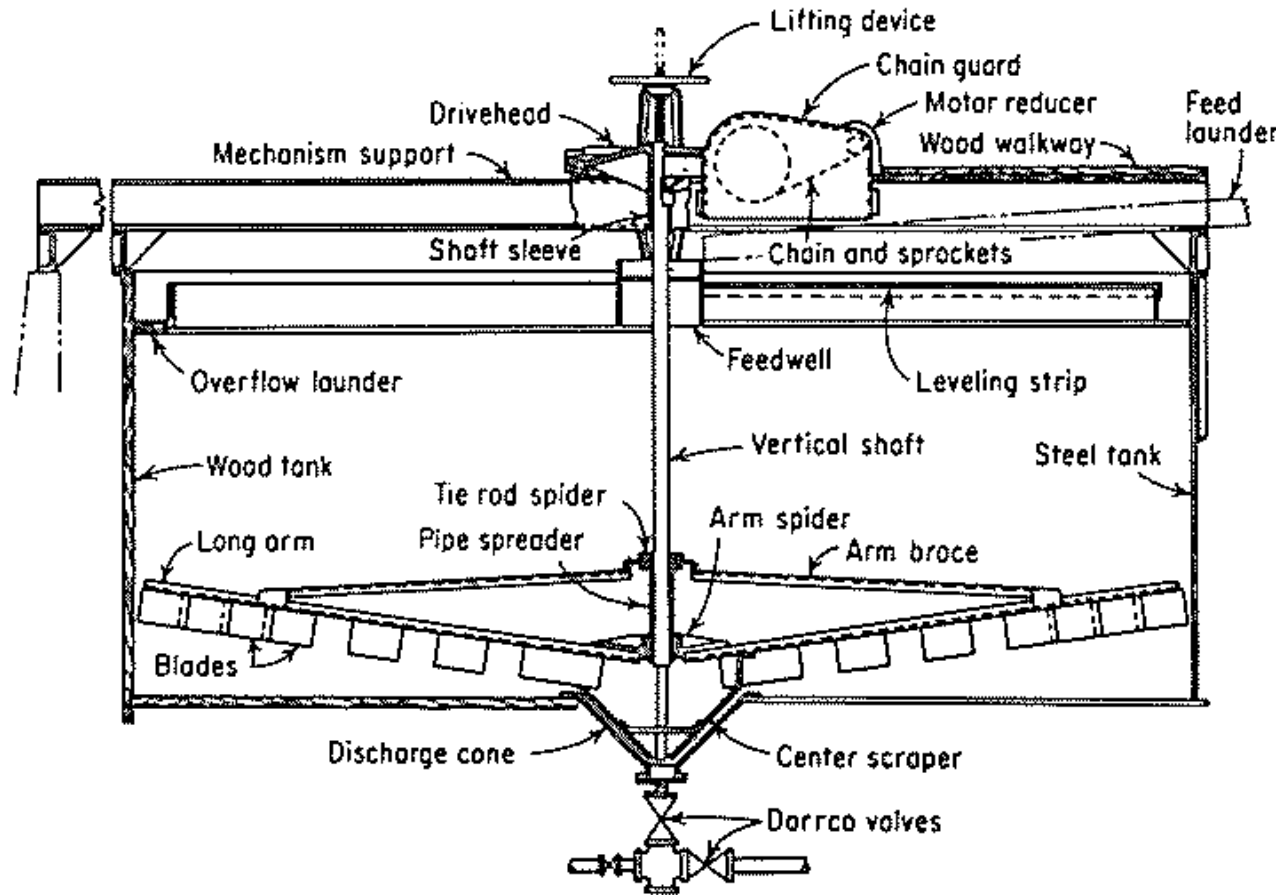
# *Steady State Leaching*

## **Thickeners:**

- It increases the ratio of solid to liquid in a dilute suspension of finely sized particles by settling and decanting, producing clear liquid and thickened sludge.
- It reduces filtering costs, readily transportable.

# *Steady State Leaching*

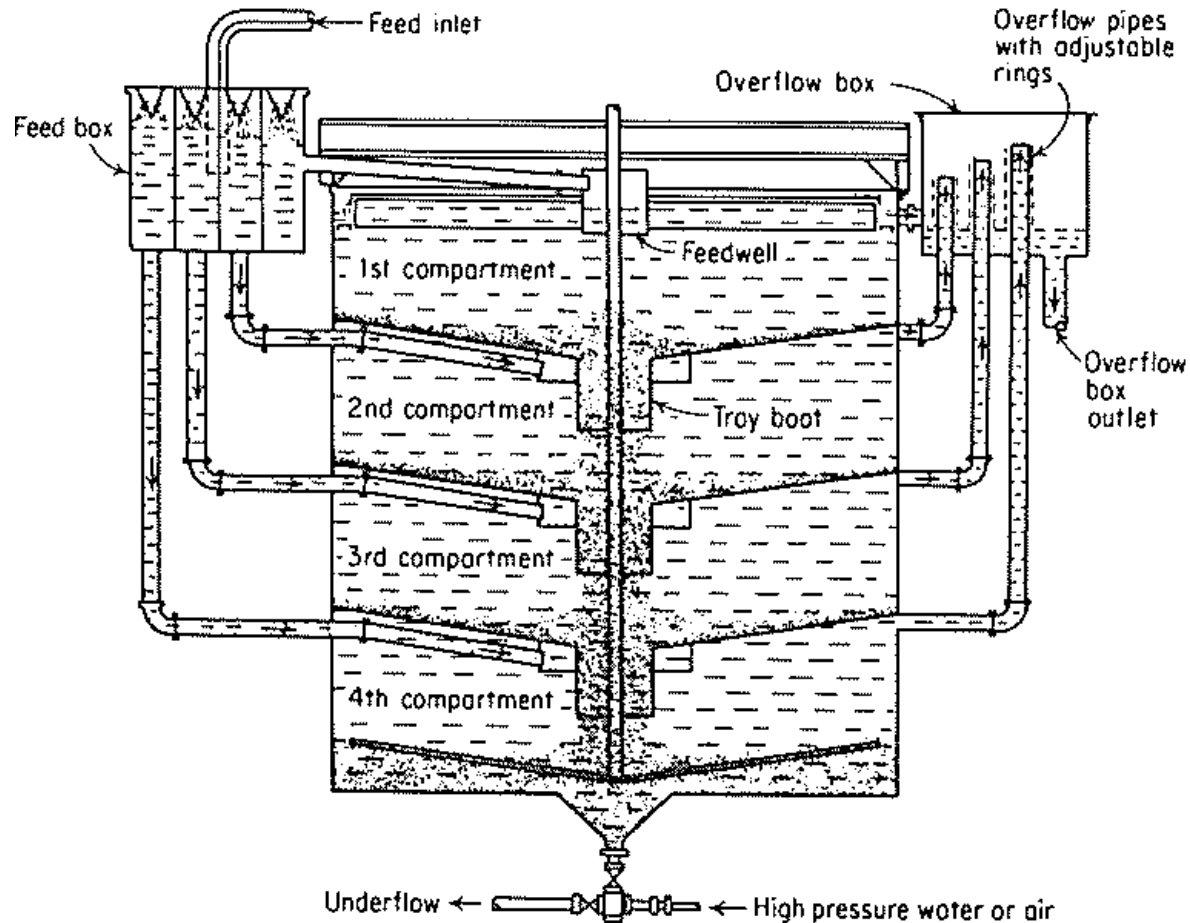
**Dorr Thickeners:**



SECTION ELEVATION

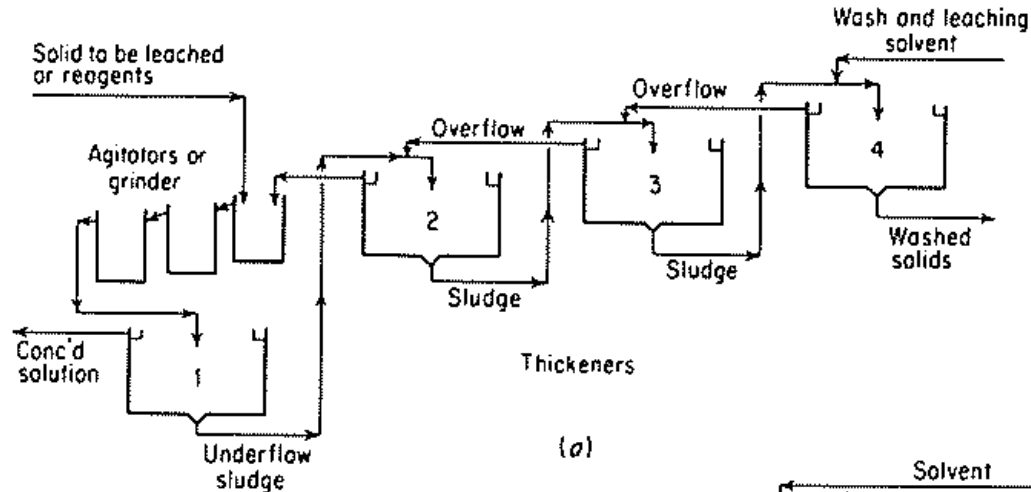
# *Steady State Leaching*

**Dorr Balanced-tray Thickeners:**

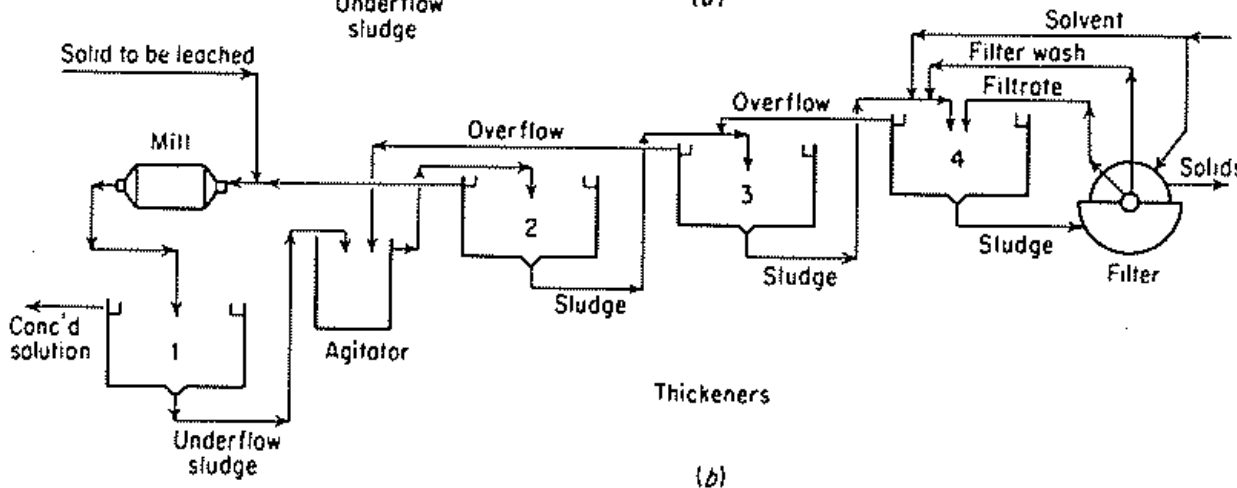


# Steady State Leaching

## Continuous Countercurrent Decantation (CCD):



a) Simple flowsheet

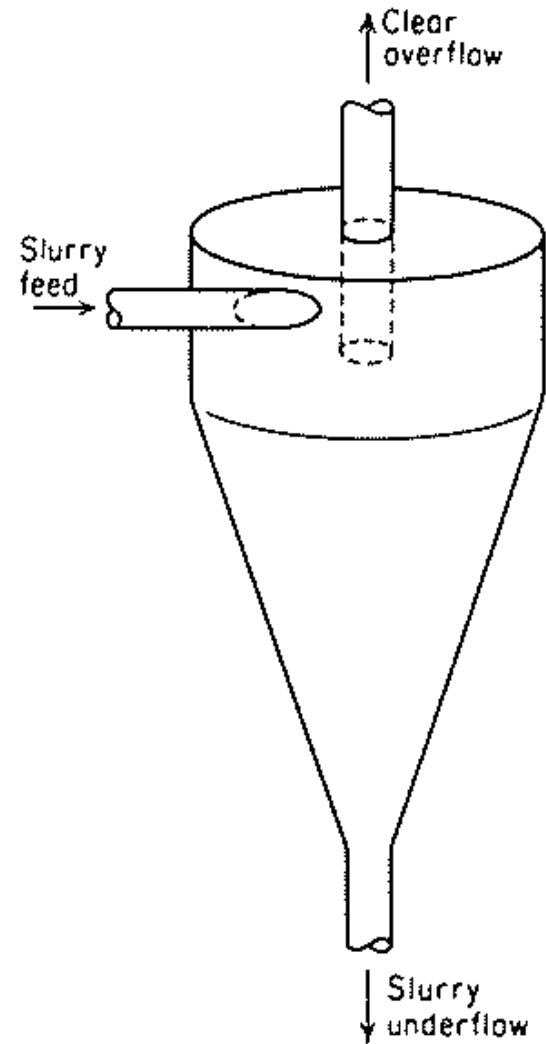


a) Flowsheet with intermediate agitation and filtration of washed solids

# *Steady State Leaching*

## **Hydrocyclones:**

- ✓ It is same as of size of classifications of solids.
- ✓ Used for solid-liquid separation in place of thickeners in countercurrent washings of solids.



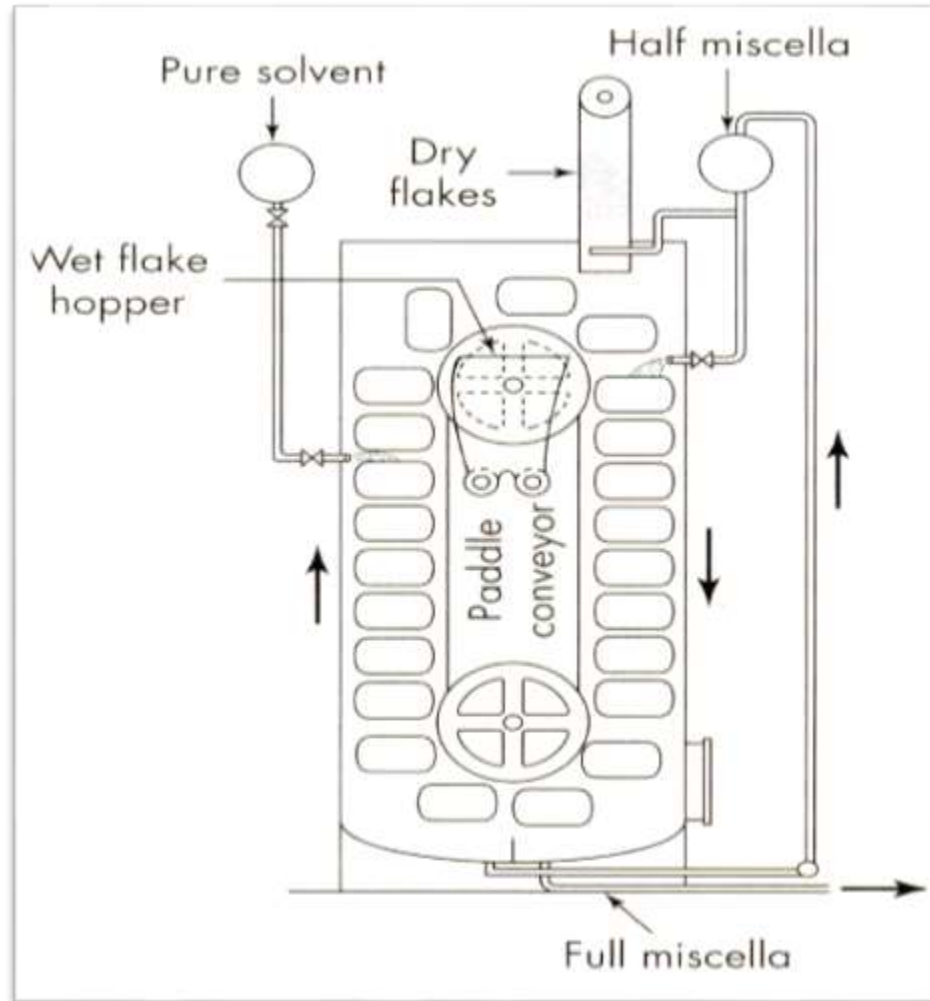
# *Steady State Leaching*

## **BOLLMAN EXTRACTOR:**

- Contains a bucket elevator in a closed casing.
- The buckets are loaded with flaky solids such as soybeans.
- The solids are sprayed with appropriate amount of half miscella as they travel downward.
- Half miscella is the intermediate solvent containing some extracted oil and some small solid particles.
- As solids and solvent flow concurrently down the right-hand side of the machine, the solvent extracts more oil from the beans.

# *Steady State Leaching*

## **BOLLMAN EXTRACTOR:**



# *Steady State Leaching*

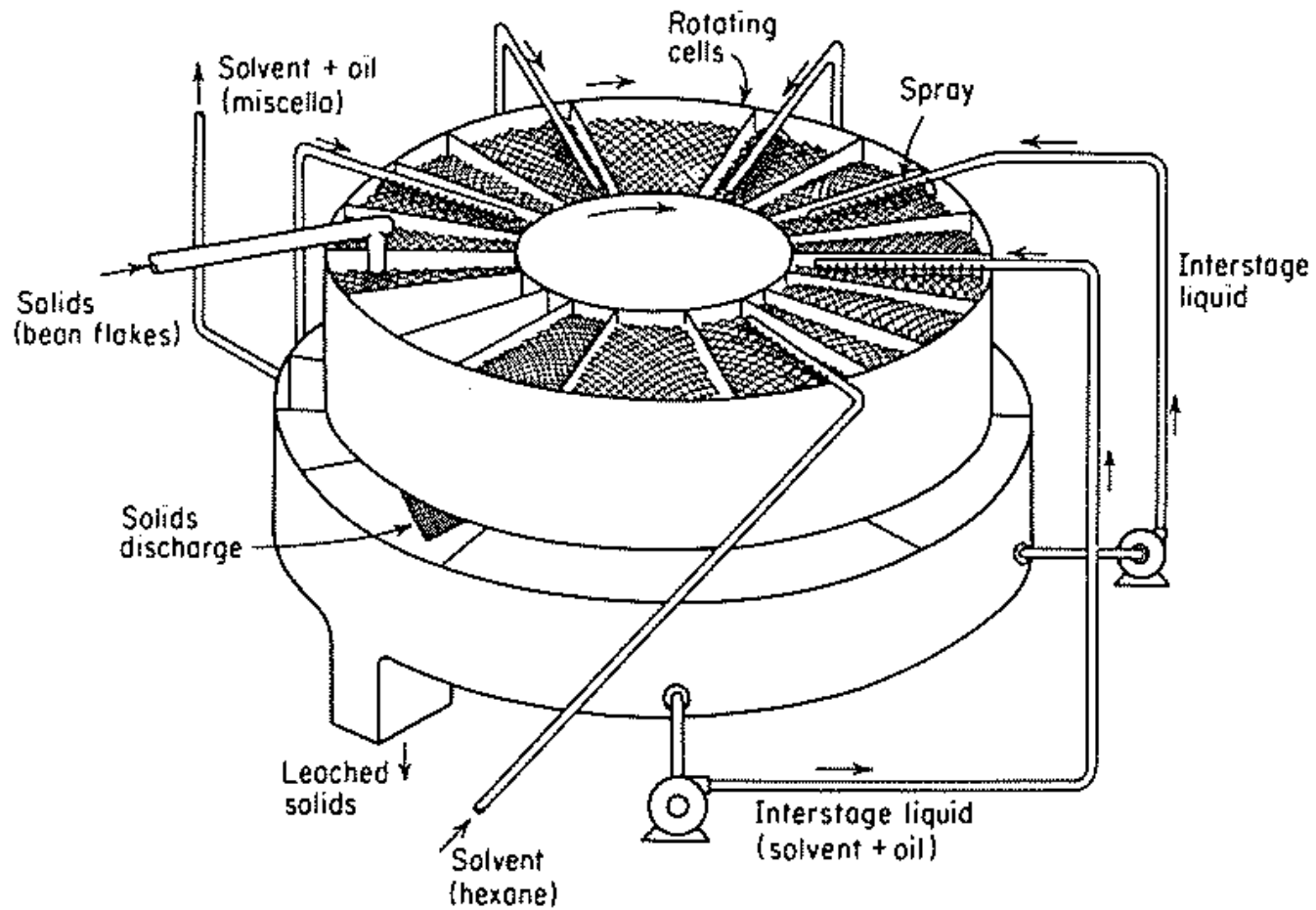
## **ROTOCEL EXTRACTOR:**

- A **horizontal basket** is divided into **walled compartments** with a floor that is permeable to the liquid.
- The basket **rotates** slowly about a vertical axis.
- **Solid are admitted** to each compartment at feed point.
- The **compartments** then pass a number of solvent sprays, a drainage section and a discharge point.
- To give countercurrent extraction, the **fresh solvent is fed** only to the last compartment before the discharge point.



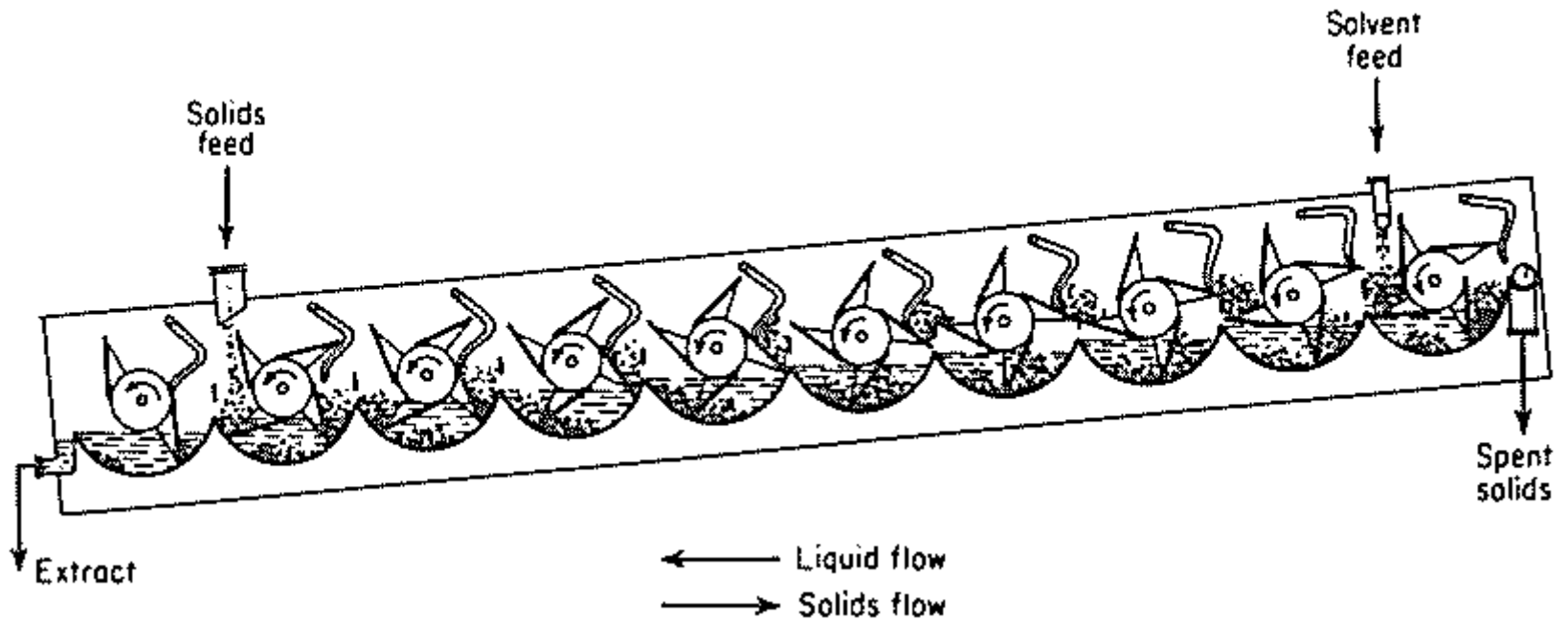
# *Steady State Leaching*

## ROTOCEL EXTRACTOR:



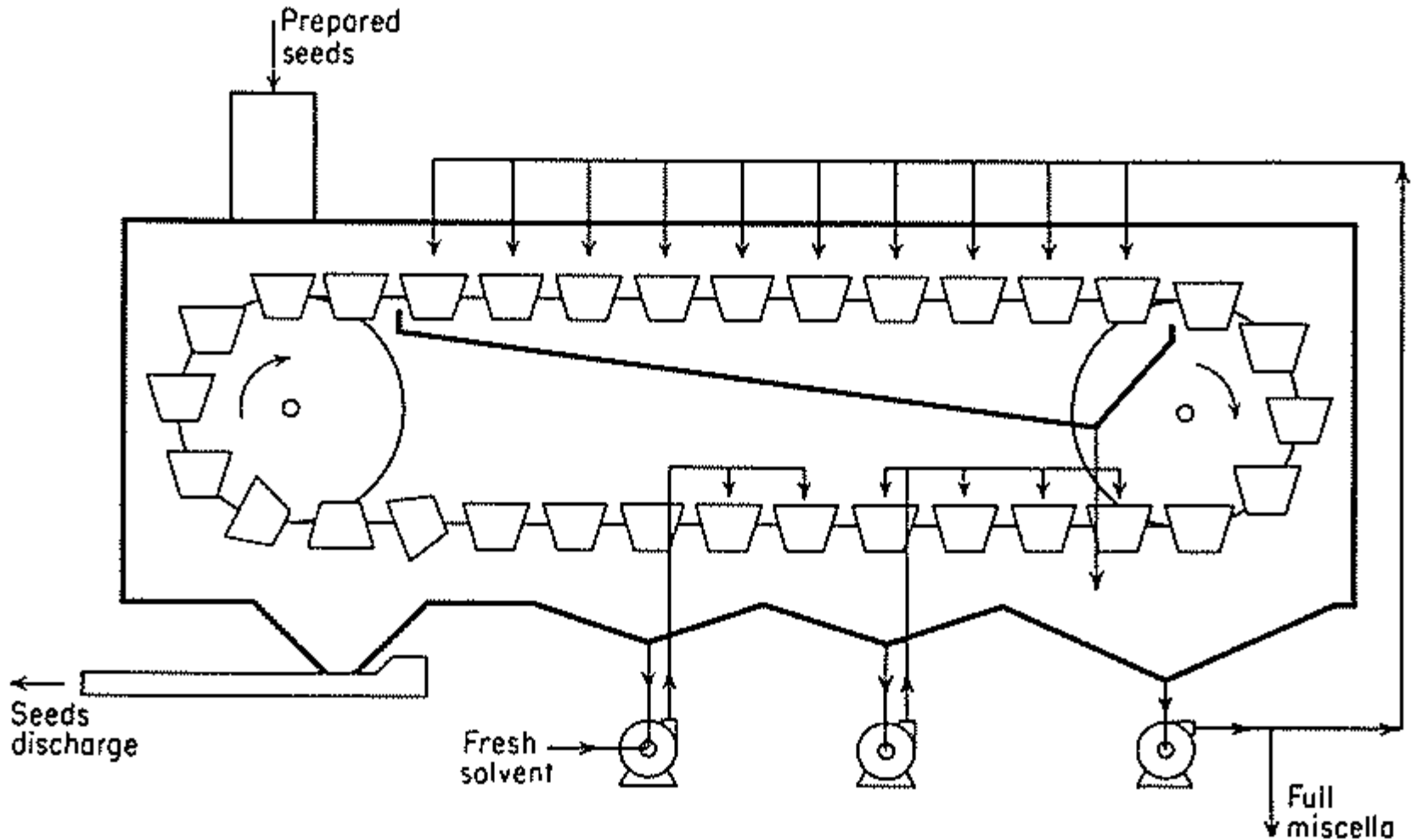
# *Steady State Leaching*

## **KENNEDY EXTRACTOR:**



# *Steady State Leaching*

## CONTINUOUS HORIZONTAL EXTRACTOR:



be proud to  
*Create and  
Celebrate*

Another **'A'**  
**Day!**

~ Ty Howard

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Thank you.... 😊