"Spot It" for Unit Operations Videos

Participants:

DEALER, SCRIBE, PLAYERS.

Setting up the Game

Each ***Spot It*** card has five UO video topics on it. Place the deck of ***Spot It*** cards on the table near the DEALER, face down. The DEALER gives each player one card, face down.

The Play.

The DEALER turns over one card from the pile. The PLAYERS turn over their cards. Each PLAYER attempts to MATCH a Unit Operation on his/her card with a DIFFERENT Unit Operation on the card in the center of the table. A MATCH is defined as something SIGNIFICANT that these two Unit Operations have in common. When you have a MATCH, call it out and explain the MATCH to the group. If the MATCH is correct, take the card as proof of your point and place it face up on your current card; the captured card becomes your new card to play with. The SCRIBE records the MATCH (so that we can study all the MATCHES for the final). The DEALER signals the start of the next round by turning over a new card from the deck.

> *FOR EXAMPLE:*
>
> *You have CONVENTIONAL DISTILLATION and the card in the center has SINGLE EFFECT EVAPORATORS. You call this a MATCH because both of these units have in common very high energy costs. The first player to call a valid MATCH, takes the card and scores a point. The PLAYERS are the judges as to whether the MATCH is valid.*

Disallowed Matches

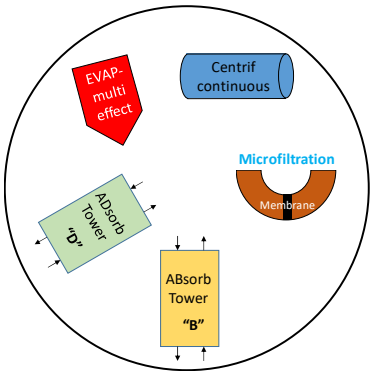
A MATCH within the same "Topic" (1-9) is not valid, for example, AZEOTROPIC DISTILLATION may not be matched with CONVENTIONAL DISTILLATION, as both are topic 7. You also may not MATCH with your own group's topic.

Winning the Game

Play ends when the DEALER runs out of cards. Score each claimed card as 1 point. The SCRIBE transmits the description of the MATCHES to Dr. Morrison.

More Examples of MATCHES

1. High maintenance effort required
2. High operating costs
3. High capital costs
4. Significant mass AND energy transfer takes place
5. Has mass accumulation in the unit (requires regeneration)
6. Used in water purification



MATCHES GAME 1

- Evaporators $ distillation $ dryers use heat transfer (evaporation - removes moisture)
- Centrif. batch $ continuous filtration do not use heat transfer
- adsorb. tower $ microfiltration are concentration driven
- evaporators $ distillation use the materials' volatility
- evaporators $ dryers are used in the paper industry
- azeotropic distillation $ adsorption tower have high capital costs (
- centrifugation is similar to filtration b/c in centrifugation you can separate a virus into a top layer & leave buffer into the bottom layer & you can use filtration to put the buffers through to remove impurities like a 0.2um filter.
- Reverse osmosis $ continuous centrif. are both pressure driven
- continuous dryers $ cont. filtration separation is improved by adding more units. (also evaporation)
- multi-effect evaporators $ distillation towers are huge
- cont. centrifuge $ ultrafiltration both have a cake that builds up which has to be cleaned
- ab/d sorption towers $ distillation columns both are expensive and cause a lot of plant downtime

MATCHES GAME 2

- ~~azeotropic distillation + batch centrifuge~~
  ~~both methods of separation~~
- batch centrifuge + batch dryer
  ~~both batch processes~~ Separate liquids + solids
- ~~azeotropic distillation~~
- centrifuge batch + filtration continuous
  both filter particles based on size
- Micro filtration + reverse osmosis
  both filter impurities from water
- conventional distillation + absorption towers
  both use stages
- continuous centrifugation + microfiltration
  both expensive
- batch dryer + multieffective evaporator
  both require a lot of heat
- azeotropic distillation + continuous drying
  both require a lot of heat
- Single effective evaporator + batch dryer
  high cost of operator wages
- dryer continuous + filtration continuous
  less manual labor
- reverse osmosis + batch centrifugation
  (dialysis) → both used in medical field (virus removal)
- continuous dryer + continuous filtration
  low labor processes
- reverse osmosis + continuous filtration
  both mass transfer processes
- Multieffective evaporators + multicomponent distillation
  both expensive

- absorption tower + continuous dryer
  both used to remove water from hydrocarbon stream to ppm amounts
- batch dryer + batch centrifugation
  both used to dry laundry
- absorption tower + continuous filtration
  abs. tower has con. filtration within the process
- absorption tower + azeotropic distillation
  need to add materials to achieve separation
- absorption tower + continuous filtration
  both have accumulation
- batch dryer + centrifugation + continuous drying
  both require balancing to operate

More on back →

- ultrafiltration + absorb towers
  foul easily
- ~~ultrafiltration~~

MATCHES GAME 3

Reverse Osmosis w/ Microfiltration: water purification

Microfiltration w/ Continuous Filtration: similar mass streams

Batch Centrif. w/ Continuous Filtration: both used in bio-processing

Dryer Continuous w/ Single effect Evap: both use alot of heat

Driers w/ Distillation: both use boiling pts to separate

Batch Driers w/ Batch Centrifuge: both have high maintanence costs

: both have small output volumes

Continuous Centrif. w/ Ultrafiltration: both have lower energy costs

Continuous Centrif. w/ Continuous Drier: often used in series in the same processes

Multicomponent Distillation w/ Multieffect evap: both are multi step systems

Batch Centrifuge w/ Filtration Continuous: to separate liquids/liquids

: both can use perforated screens to separate liq/solids

Single effect Evap w/ Batch Centrifuge: both used to either concentrate a desired product or remove water

single effect Evap w/ Batch Driers: both have high energy costs

Batch Centrifugatin w/ Reverse Osmosis: both used in pollution remediation.

Multicomp Distillation w/ Continuous Driers: both have a lot of wasted heat

~~Ultrafiltration w/~~ Filtration Continuous w/ Multicomp Distillation: both take up alot of space

Batch Centrif. w/ Conventional Distillation: both are old technology

Multieffect evap w/ Reverse osmosis: both can be used in salt production

MATCHES GAMEY

- Conventional distillation and single effect evaporators are a match because they have very high energy costs.
- Conventional distillation and absorb towers because they are both Separating units.
- Filtration continuous and microfiltration of a membrane because they both force something through membrane.
- Adsorb tower and multi effect evaporator because they are both used for water purification.
- Multicomponent distillation and batch dryer because there is a phase change.
- Absorb tower and microfiltration because they are both pressure dependent to work.
- Continuous filtration and azetropic distillation because they have to be stopped because you can't separate anymore.
- Multi effect evaporator and centrifuge batche because they have high maintenance.

Multi effect evaporator and azetropic distillation because their both inversely effected by intramolecular forces.

Adsorb tower and conventional distillation because they both require packing.

Adsorb tower and membrane ultrafiltration because they are both dependent on surface area.

Adsorb tower and absorb tower because they both use a solute to extract a solvent

Continuous centrifugation and batch drying because they both use mechanical work.

membrane microfiltration and continuous filtration because they both have high maintenance

membrane ultrafiltration and azetropic distillation because they both have an optimal temperature.

Batch dryer and continuous filtration because they're both separating solids from liquids.

- Continious dryer and azetropic distillation because they both require multiple stages.
- Multi effect evaporators and batch-dryer both require high temperature.
- Ultrafiltration membrane and batch centrifuge can be used on small scale like in a lab.
- Multieffect evaporators and absorption tower because they have to be used on a large scale.
- Azetropic distillation and single effect evaporators because they are both very dependent on thermodynamics,
- Multicomponent distillation and absorb tower both have high costs to go taller
- ~~Batch Ultrafiltration membrane and~~

MATCHES ~~Group~~ GAME 5

- Evaporators and reverse osmosis are both used to purify water
- Filtration and reverse osmosis both use pressure to separate
- Dryers and distillation are both energy intensive.
- Microfiltration and batch centrifugation are pretreatments for RO and dryers respectively
- Adsorption and batch centrifugation both require regeneration
- Dryers and evaporators require heat to drive off a volatile
- Dryers and evaporators are both used to produce solid products
- Centrifugation and Adsorption can be used for liquid-liquid separation
- Distillation and evaporators are reliant on inputs having different boiling points
- Filtration and centrifugation both rely on kinetic input instead of thermal
- Evaporators and continuous dryers are both used in the paper industry
- Azeotropic distillation and absorption require another component to affect their separation
- Microfiltration and batch centrifugation can be used on a smaller scale
- Reverse Osmosis and Azeotropic distillation both require high capital costs
- Filtration and membrane separations use a media to obstruct flow to affect their separation

MATCHES GAME C

- Continuous Filtration and Absorption are both continuous
- Dryer - continuous and Evaporator - single use heat to seperate
- Evaporation - Multiple effect and Continuous centrifugation contain multiple pieces of equipment in series
- Evaporation - multi and Conventional distillation seperate based on Boiling Point
- Azeotropic Distillation and Absorption seperate hard to seperate mixtures, as well as use an add-in to help the seperation
- Continuous Filtration and continuous drying are used to remove water
- Cont. Centrifugation and Reverse Osmosis require high energy input. Osmosis requires pressure, Centrifugation requires high rotation
- Conventional Distillation and Absorption use packing in the columns
- Continuous filtration and Single-evaporation can be used to seperate solids from a liquid.
- Evaporation - single and Batch Centrifugation are used when you do your laundry
- Batch Centrifugation and Continuous filtration contain rotating parts + the rotation causes a safety hazard
- Distillation and evaporation equipment needs to be cleaned due to scaling

- Single-effect evaporators and Conventional distillation are both common in industry.
- Ultrafiltration and Continuous Centrifugation both used in Food industry.
- Batch Centrifugation and Multicomponent distillation struggle with azeotropes/miscible fluids
- Azeotropic Distillation and Continuous filtration are used in the production of alcoholic drinks

MATCHES GAME 7

1. Multi-Comp Distillation + EVAP-Single Effect have high energy needs ΔH_{vap} - latent heat changes
2. Adsorbtion tower + Multicomp DS - Both have a column column processes
3. Reverse Osmosis + Continuos Dryer Both involve removal of water from other products
4. Multi-comp Distillation and continuos filtration remove undesired liquids
5. Conventional Distillation and single effect evap - Distillation is Stage wise process
6. Continuos cent and Multicomp DS Both use physical properties to seperate components.
7. Adsorbtion and Continuos filtration both use solid beds to remove undesired product
8. Azeotropic DISS and ABsorbtion Both can Seperate past Azeotropes
9. Batch Cent and Batch Drying are both used in your home laundry
10. Adsorbtion + Filtration are components in your car.
11. Filtration cont + Batch cent Both require high mechanical energy

(13.) Distillation + Absorbtion Both depend on vapor-liquid contact.

(14) Continuous Driers and continous filtration are both used in the paper industry.

(15.) Azeotropic Distillation + Micro Filtration are both used in petroleum ~~&~~ industry.

(16) Batch Centrifuge + Adsorbtion are used in the food industry.

(17.) Batch Dries + Convec Dist are OK

(18.) Mult Dist + Multieveap can be modeled in UNISIM

MATCHES GAME

1. Ultrafication - Membrane + Adsorb tower "D"
   Water purification
2. Evaporator - Multieffect + Dryer - Batch
   Reduce amount of H_2O
3. Adsorption + Microfiltration
   Mass transfer on membrane v. on catalyst
4. Cont. Centrifugation and Cont. Dryers can be used to separate solids and liquids
5. Microfiltration and Multi-Effect Evaporator are both used in waste water treatment
6. Azeotropic distillation can be used to make alcoholic beverages and ultrafiltration can be used to make dairy products and both are consumable liquids
7. Multieffect evap + conventional distillation: both stage based gas/liquid separation for species purification
8. Cleaning Ultrafiltration and continuous Centrifugation periodically is important due to solid buildup
9. Azeotropic distillation and Multi-Effect Evaporators are both used in liquid-liquid extractions.
10. centrifu - continuous & Absorb Tower "B" both require pumping and run the risk of cavitation
11. Dryers and Multicomponent Distillation are continuous processes that use lots of energy and can explode if handled incorrectly
12. filtration continuous and centrif batch are both liquid-solid separations
13. reverse osmosis and azeotropic Distillation are both expensive unit-ops
14. Microfiltration and Adsorption: both require replacing filters, maintenance

IDEAS

- May be used for the same purpose (e.g. bio envir food)
- costs linked to the same thing (energy, maintenance, etc)
- Mature technology / new technology
- high capacity - small capacity
- same driving force
- high maintenance
- pollution remediation

(input)

- Versatile / hard to scale
- compact / takes up a lot of space
- needs to be installed w/ other complementary equipt
- high capital costs
- slow (fast)

topic id	group number	group number	topic (Spring 2019 Friday Project)
1a		3	Single Effect Evaporator
1b		10	Multiple Effect Evaporators
2a		16	Dryer-batch
2b	9	4	Dryer-Continuous
3a			Absorption tower (with a “b”)-tray tower
3b		5	Absorption tower (with a “b”)-packed tower
4	18	13	Adsorption tower (with a “d”)-fixed bed
5a	15	2	Membrane separation-Reverse osmosis
5b		17	Membrane separation-Microfiltration
5c		6	Membrane separation-Ultrafiltration
6		11	Filtration-continuous
7a		19	Conventional distillation
7b		14	Azeotropic distillation
7c	8	7	Multicomponent distillation
8			Extraction
9a		1	Centrifugation-batch
9b		12	Centrifugation-continuous