Preserving Aroma in Processed Hops

2019 NEBRASKA GROWER AND BREWER CONFERENCE

01/13/19

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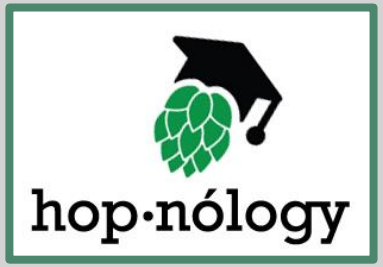
PRODUCTION AND BREWING SCIENCE

HOPNOLOGY



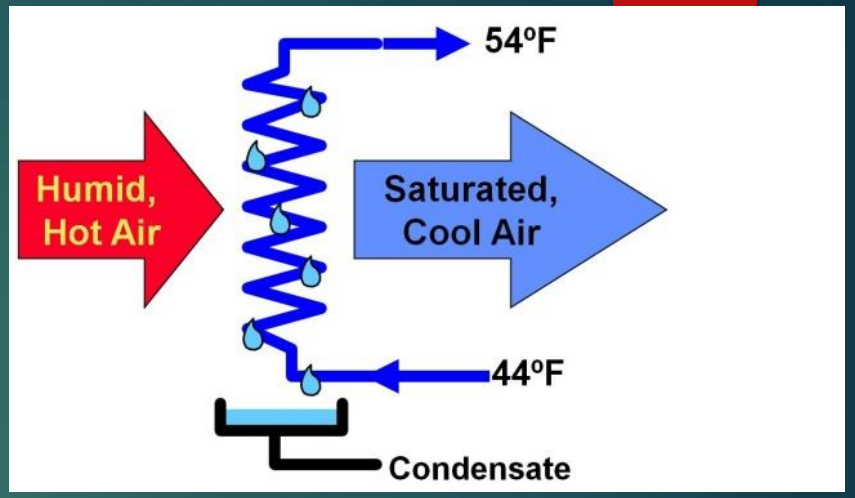
It can only go downhill from here…

- Processed aroma will never be better than the harvest quality
- Processing should
  - Reduce moisture
  - Reduce or stop oxidation
  - Stop spoiling (mold, etc)
  - Eliminate light hitting hops
  - Add value to the customer
  - Preserve flavor and bittering

Lowering RH

- If we need less than 50%, how do we get there?

1. Heat
   - Direct fired burner
   - Furnace (with heat exchanger)
   - Steam coil
2. Dehumidification
   - Vapor compression cycle
   - Desiccant



Pros & Cons of Heat

PROS

Fast throughput

Smaller drying space

Easy to understand

Lots of examples to copy

Relatively low first cost

Cons

Over drying extremely easy

Poor moisture content uniformity

Losses of aroma compounds

Considerable fire risk

Elevated HSI (oxidation)

Pros & Cons of Dehumidification

PROS

Easy to understand

Retains more aroma

Extremely uniform moisture

Very low HSI (low oxidation)

No risk of over drying

CONS

Longer drying times

Larger drying space

Higher first cost

Newer technology

Studies

MBAA study by Val Peacock

- *A Comparison of Hop Drying with Unheated, Dehumidified Air Versus Traditional Drying with Heated Air*

Findings:

- *Properly sized fans in dehumidified drying systems provide much more uniform drying than compared to heated systems*
- *midified systems show much lower HSI (0.19) than heated systems (0.28)*
- *Overall DH drying time is similar to heated systems*

Studies

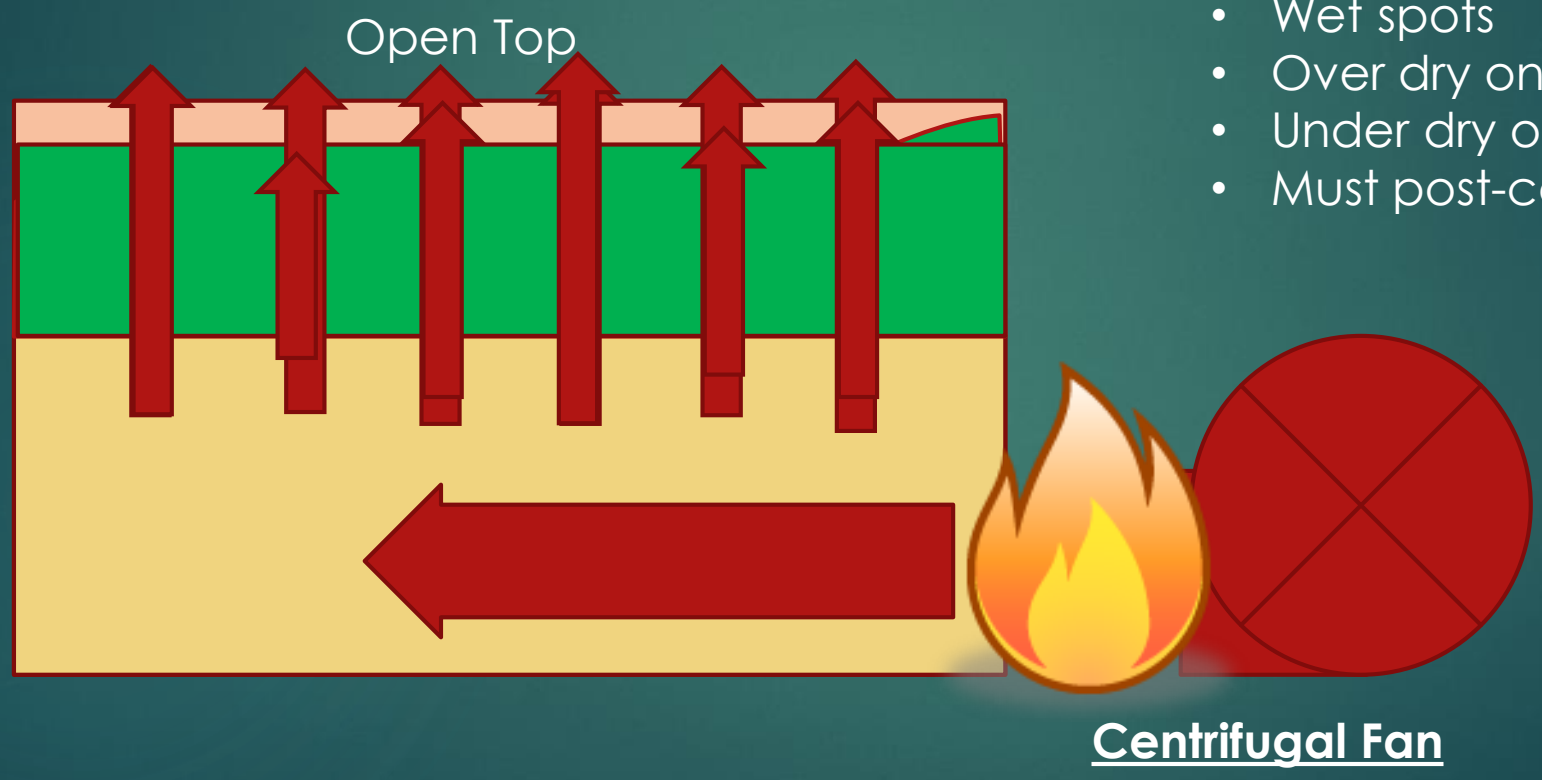
USDA Grant Research by Gorst Valley Hops

- *Impact of Hop Drying Temperature on Beer Quality*

Findings

- Temperatures over 100F decrease key aroma chemical levels in hops
  - "juicy" and "floral" components moderately impacted
  - "black currant" and "dank" components heavily impacted
  - "Pineapple and tropical fruit, melon" heavily impacted
- Temperatures over 120F decrease key hop aroma chemicals in finished beer
  - Taste panel data shows hops dried at 120F and above produced a flat, more bland aroma profile
- Temperatures less than 100F produced hop aromas preferred by taste panel

Stationary Heated Bed

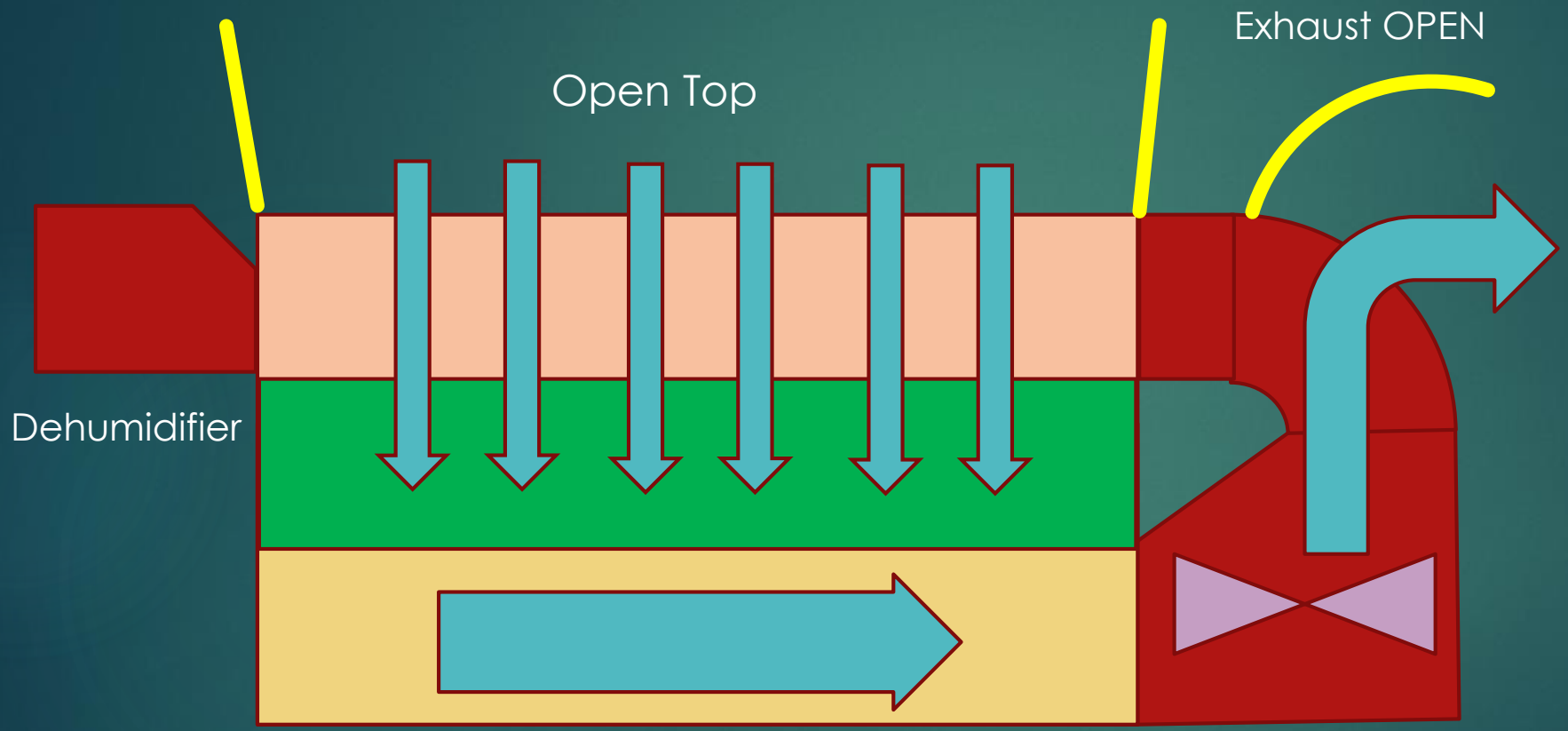


- Uneven air flow
- Hot spots
- Wet spots
- Over dry on bottom
- Under dry on top
- Must post-condition

Centrifugal Fan

Stationary Dehumidified Bed

2-Stage Drying System



OPEN MODE

- Uneven air flow
- Hot spots
- Wet spots
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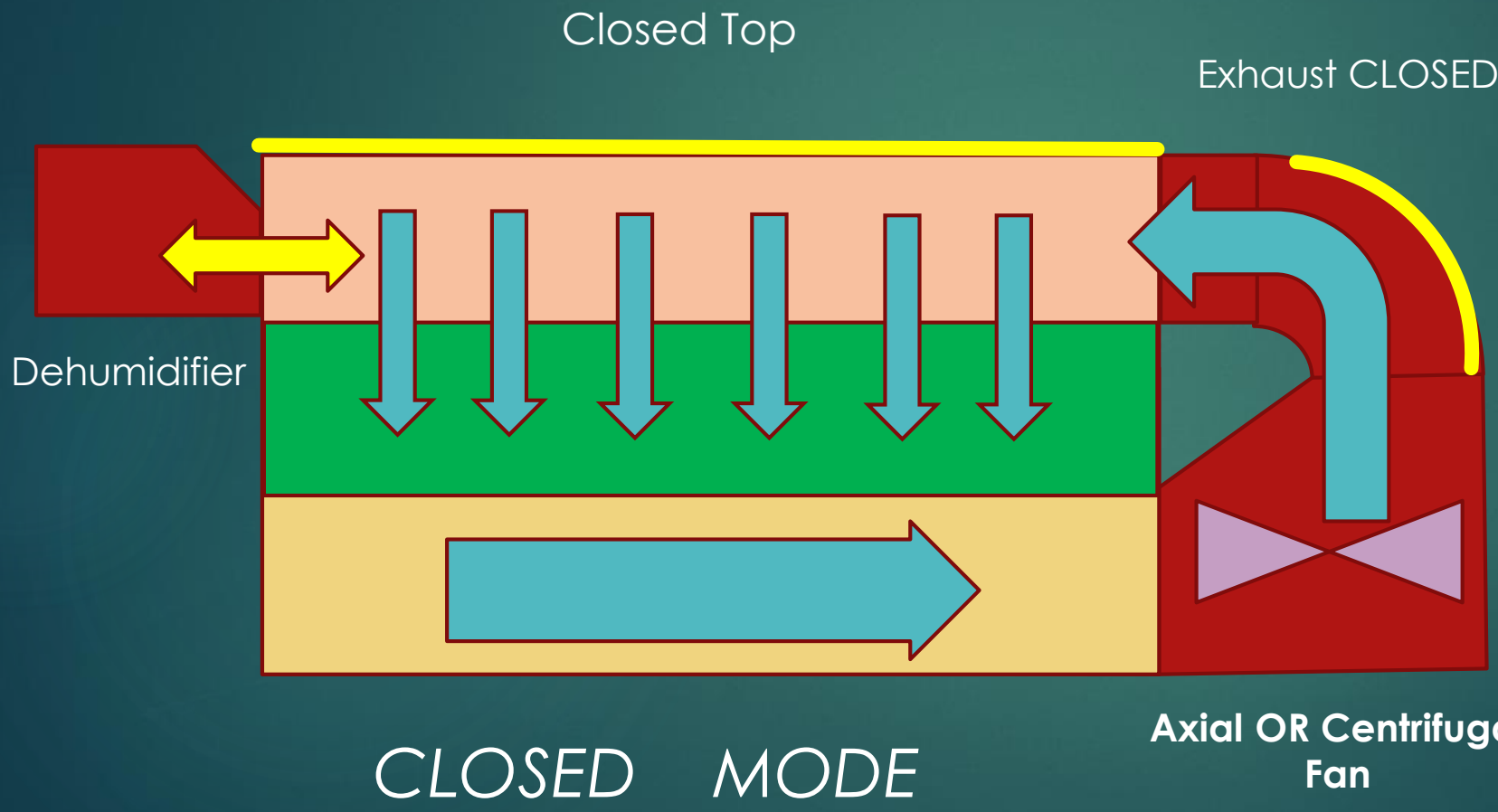
- Under dry on top
- Must post-condition

Stationary Dehumidified Bed

2-Stage Drying System



CLOSED MODE

- Very even airflow
- Uniform bed drying
- No Over-Drying
- No HEAT additions
- No Conditioning
- Longer dry time
- Improved Hop Storage Index

Post Drying Handling

- Oxygen and moisture drive degradation in storage
- Small whole leaf quantities can be immediately vacuum packed in proper packaging
- Any storage of dry hops must:
  1. Reduce exposure of hops to oxygen
  2. Reduce or eliminate moisture reabsorption
  3. Limit the rate of oxidation by lowering the temperature
- Explore in more detail

From Dryer to Finished Packaging

PROS

- No need for intermediate storage
- No pelletizing costs

CONS

- Smaller market for whole leaf hops
- Reduced storage time by 20-30%
- Requires ~20x more cold storage space
- Spend more $ on packaging

Dryer to Baling

PROS

Allows for easier handling and storage of large quantities of dry hops

Increases density and reduced exposure to oxygen

Higher density is less susceptible to temperature swings

7:1 compression frees up lots more cold storage space

Easier transport to pelletizing operation

CONS

Additional equipment required (usually custom for small growers)

Bales are heavy and bulky to mover around

Additional step exposes hops to risks

Dryer or Baler to Pelletizer

PROS

Industry standard hop form (T90 pellets used by >95% of craft brewers)

20x compression eliminates oxygen from pellet interior (almost…)

Reduces surface area exposed to oxygen

Must easier to gas purge and vacuum package than whole leaf

CONS

Expensive equipment required

Food Processor license likely required

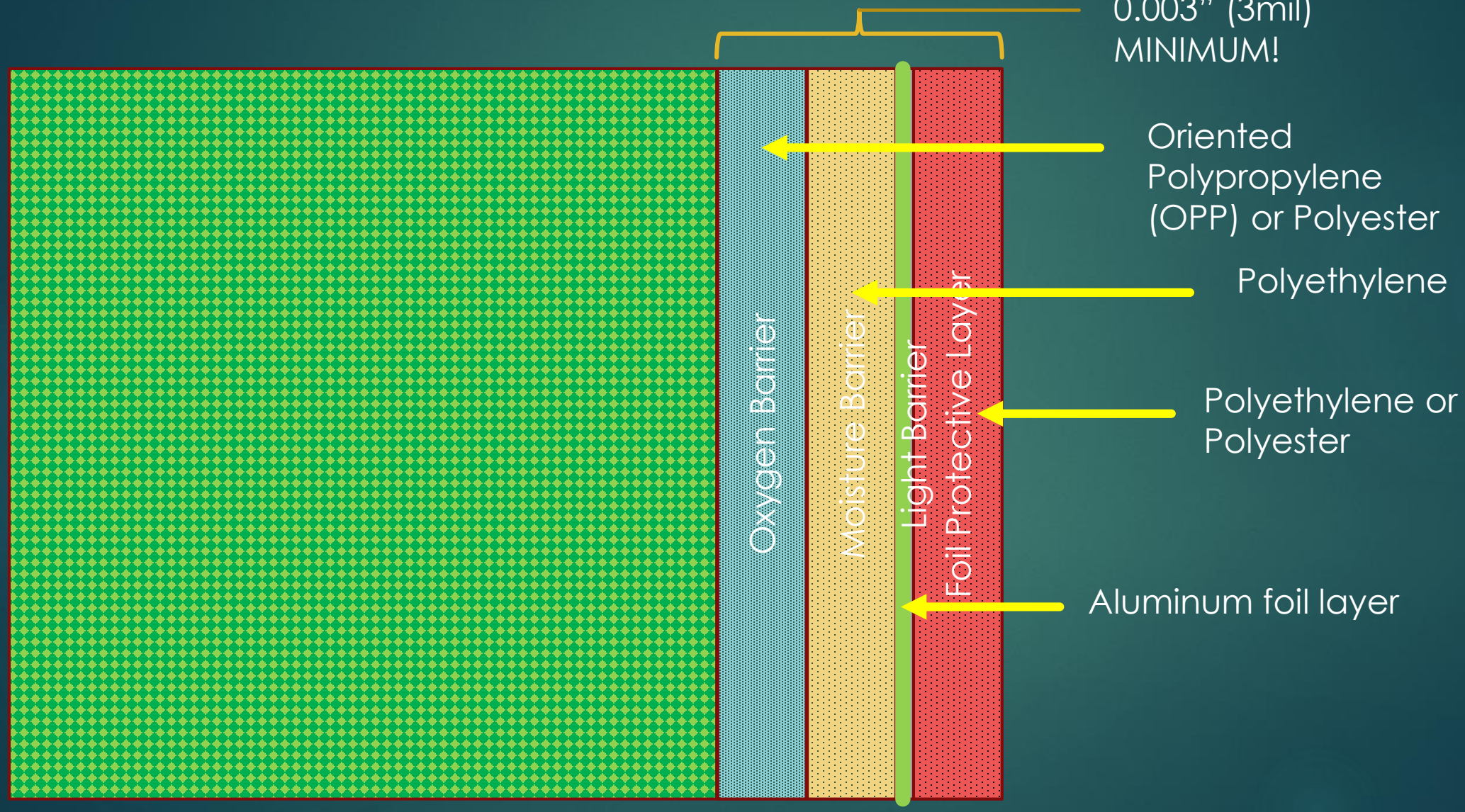
Requires highly experienced operator to ensure quality

Suitable for larger volumes

Choose Packing Gear Wisely

- Just because it's metallic doesn't mean it's the right bag for hops
- Proper *barrier* films consist of a minimum of 3 layers (4 is better) designed to keep out moisture, oxygen, and light
- Gas purging (nitrogen) is a must for cold storage past 3 months
- Sealing equipment should be capable of using a wide range of pouch materials

Barrier Film Construction



Vacuum vs Pillow

- Is it better to have a hard pack or soft "pillow" pack?

- Hard pack
  - Created tiny micro-cracks in laminate
  - Can result in vacuum loss over time
  - Hard for brewers to break apart
- Pillow Pack
  - Requires more N2
  - Harder to find leaking bags
  - Easier for brewer to dump

QUESTIONS?

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- On-line classes
- Podcasts
- Research
- Consulting
- Speaking

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