



# Beginning Sugarmaking: Trees, Taps, Tubing & Tanks

George Cook  
UVM Extension  
Maple Specialist





# Identifying the Maples

- **Sugar Maple**

- Brown twig
- Sharp bud
- Smooth leaf

- **Red Maple**

- Red twig
- Round bud
- Rough leaf



# Selecting Trees to Tap



- 10" – 12" DBH
- Healthy
- Accessible



# Characteristics of Tapable Trees

Tapholes in healthy trees usually close in 2-3 years.

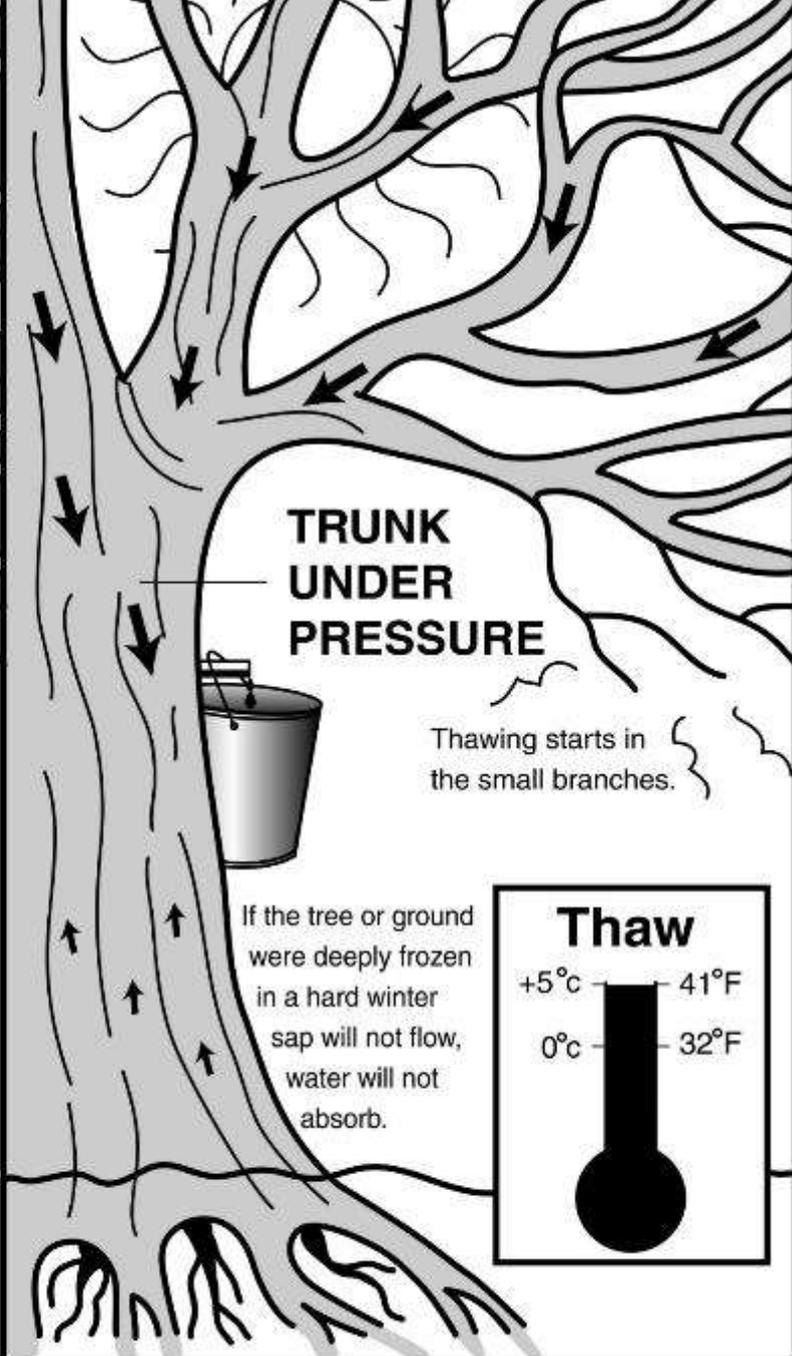
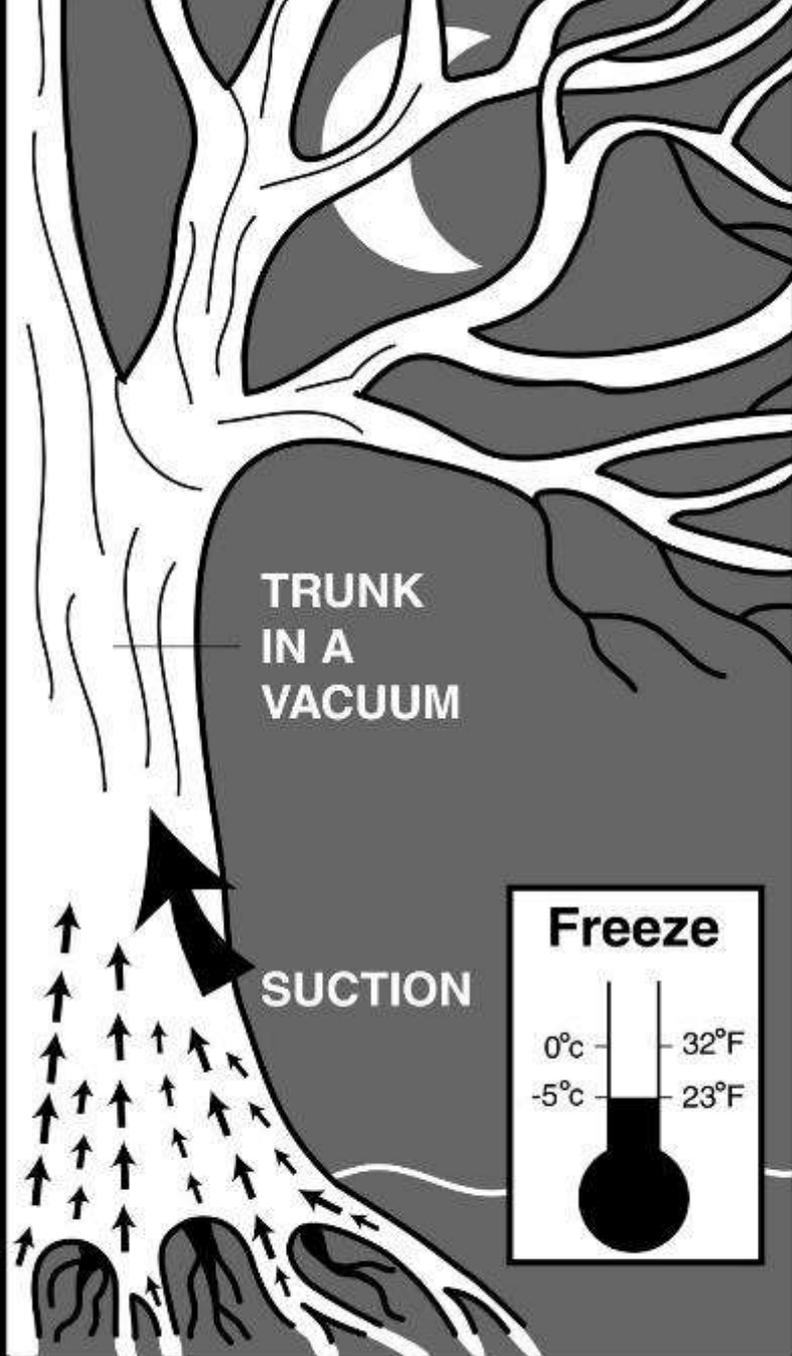
- Rate of taphole closure is a good indicator of tree health.



# Timing

- February – April
- Be alert for highs mid-30s to 40s and lows in the 20s.
- Earlier – southern areas & southern exposure, lower elevations
- New to the area? Check with local sugarmakers
- 5 – 8 week “normal” season
- +/- 12 - 15 “runs” during the season





# Tapping Equipment

- Basic equipment required

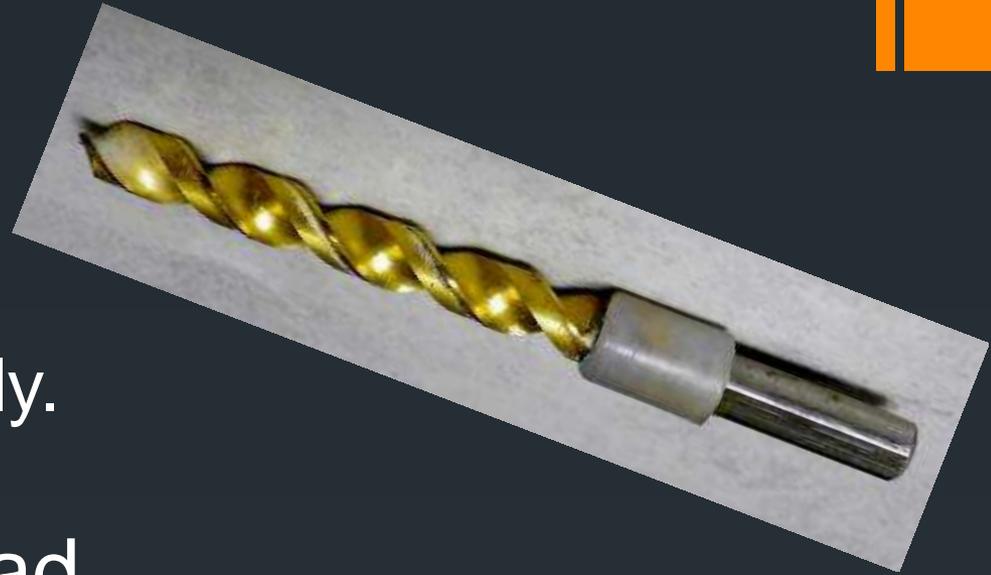
for tapping maple trees:

- Tapping drill bit
- Cordless drill
- spouts
- small mallet
- clean container to carry spouts to be installed.



# Tappers and Drill Bits

- New, Sharp bit:
  - easier to use
  - cut clean, round holes which close more quickly.
- Old, rusty, dull bits lead to:
  - Oval holes & sap leakage
  - contamination



# Tapping with Buckets

- 7/16" historical
- 5/16" today's standard
- 1 1/2" – 2" deep into clean, white sapwood
- Brace & bit or cordless drill
- Keep 6" to the side of any open taphole
- Use entire circumference
- Tap spout, do **NOT** pound!



# Tapping with Tubing

- 5/16" most common spouts
- Retire your 7/16" spouts
- 1 1/2" – 2" deep
- Tap spouts with light mallet
- 24" – 36" drop-lines
- DTS = Downhill, Tight & Straight
- Polyethylene tubing
- Vacuum for greatest efficiency



# Tubing layout

- Cull trees 1<sup>st</sup> before laying out and hanging lines!
- Serpentine laterals
  - Line that goes tree to tree
  - Limit Ys in line
- Gravity vs vacuum
- Empty into mainlines or tanks



# Mainlines

- $\frac{3}{4}$ " or larger
- Most fittings start with  $\frac{3}{4}$ "
- Polyethylene
- Layout and install wire to attach mainline to
- Attach each end, then tighten and use pull-backs as needed
- Maintain 2 – 3% slope
- When in doubt, use a hand-held site level <\$20
- 2 – 3 FT drop in every 100 FT of run



# 3/16" vs 5/16"

- More taps per laterals with 3/16"
  - Strive for 5 with 5/16"
  - 15 – 25 seems to work with 3/16"
- 3/16" best for good vertical drop
  - Most fittings now available
- Both - steep like a Mtn stream; 5% or more
- Mainlines – flatter like a river; 2-3% minimum



# 3/16" Gravity Tubing

- Relatively New
  - Innovative
  - Exciting Results
  - Up to 28" vacuum!
- 
- Mine: 2015
  - 21" on mainline,
  - 21" on 5/16" ...
  - 25" – 27.5" top of 3/16"
  - 19.5" ...limited drop, gravity



# 2016 Season

- Converted all to 3/16"
- Gravity: up to 24" Hg, limited vertical drop
- With 21" Hg vacuum on mainline : 24" – 28" Hg
- Excellent flow and volume
- Very happy with results





# Vacuum for Small-scale/Beginners

- Diaphragm Pumps
  - +/- \$1,000
- Several manufacturers
- 5" inch diaphragms
- Single & Double set-ups
- Change diaphragm annually
  - Kit runs +/- \$40
- Duckbill vs umbrella valves
- Effective for small operations – up to 500 taps





- Squirrels – a royal pain with tubing systems
- Clear Out Softwoods – squirrel habitat
- **NO Bleach** ( $\text{NaClO}$ )
  - High Sodium – squirrels like salt, too!



# Tapping Guidelines

- No tree tapped under 10" DBH
- 10" – 17" tree = 1 tap
- 18" + tree = 2 taps
- NO MORE THAN 2 taps
- Don't cluster tap
- Vacuum tubing:
  - Strive for 5
- Gravity: 10 to 12
- Serpentine, not Ys.



Quaint, but...  
Very “Old School”  
Not Recommended!



# Sap Collection

- All Food Grade – intended for food use!
- Tanks to use: Stainless, polyethylene
- Shaded & cool = **under 40° F**
- New lines keep sap cooler, black plastic water pipe gets **hot**



# Sap Collection

- Old Buckets = lead solder
- Plastic tubing systems ~ growing steadily
- Sap Bags ~ Few, mostly mid-west



# Sap Collection & Storage

- All gathering & storage tanks – **lead free** (e.g. stainless steel, fiberglass, polyethylene, etc.)
- Gather daily, boil at once
- Keep sap cool
- Strain, Filter



# Sap Storage

- How much storage do you need?
- 2 gallon per tap per day - tubing
- Plan for two days storage





**Polyethylene**



**Lead Solder**

**NO**

**Old Galvanized Steel**

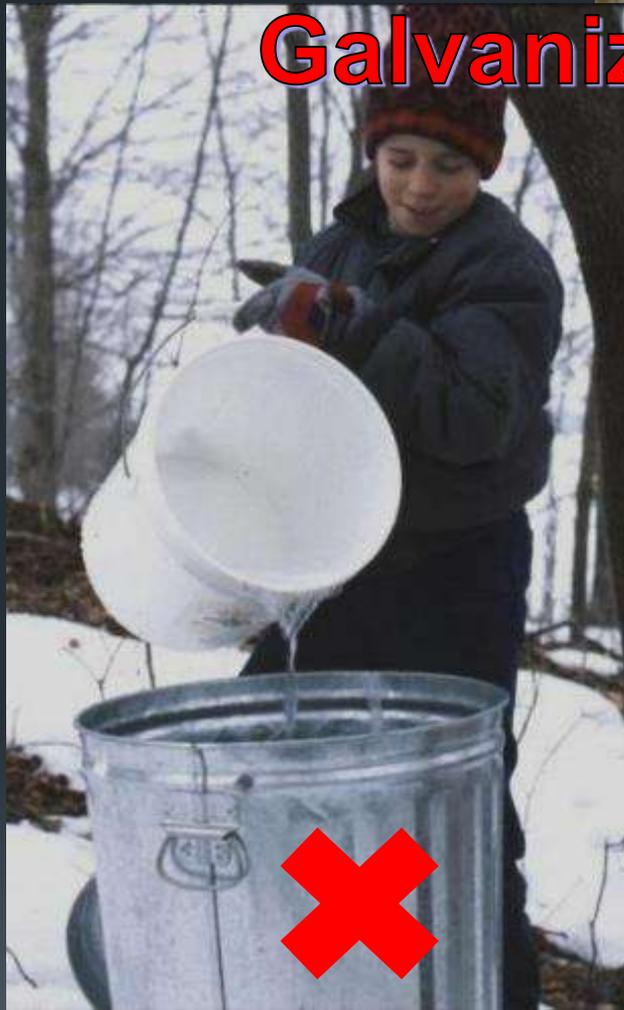


**Stainless Steel  
- outer shell**



**Stainless Steel  
- inner tank**

**Galvanized**



**Re-Grind**



**Good**

**Food Grade  
Polyethylene**



# **Sugaring Basics: Buildings, Boiling, Bottling & Bragging!**

**George Cook**

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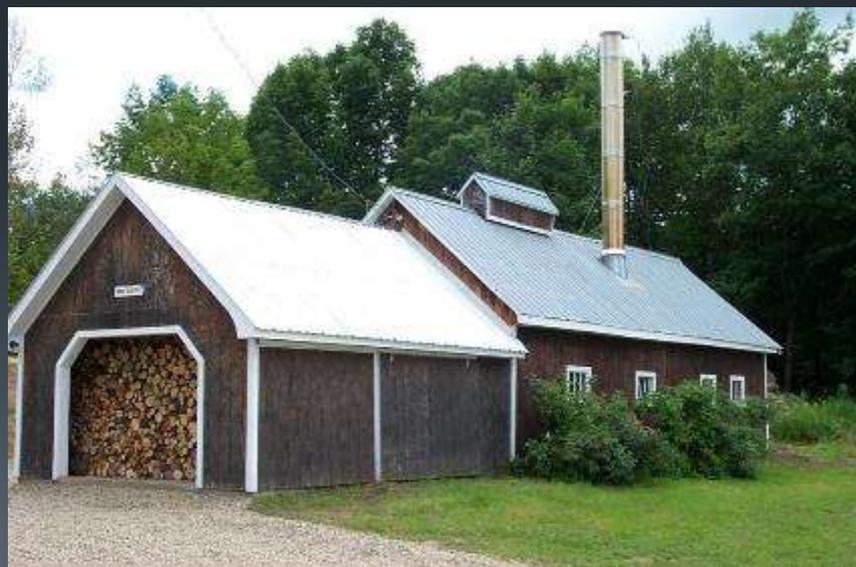
**Vermont Maple Conferences - 2016**

# Jones Rule of 86

- How many gallons sap to make a gallon of syrup:
- Measure sap sweetness
- Divide “86” by % sugar in the sap.
- Example ~ 2.4% sap; divide 86 by 2.4 = 36 gallons sap for a gallon of syrup...good
- $86 / 1.5\% \text{ sap} = 57 \dots \text{Ouch!}$



# Sugarhouses



# The early days...

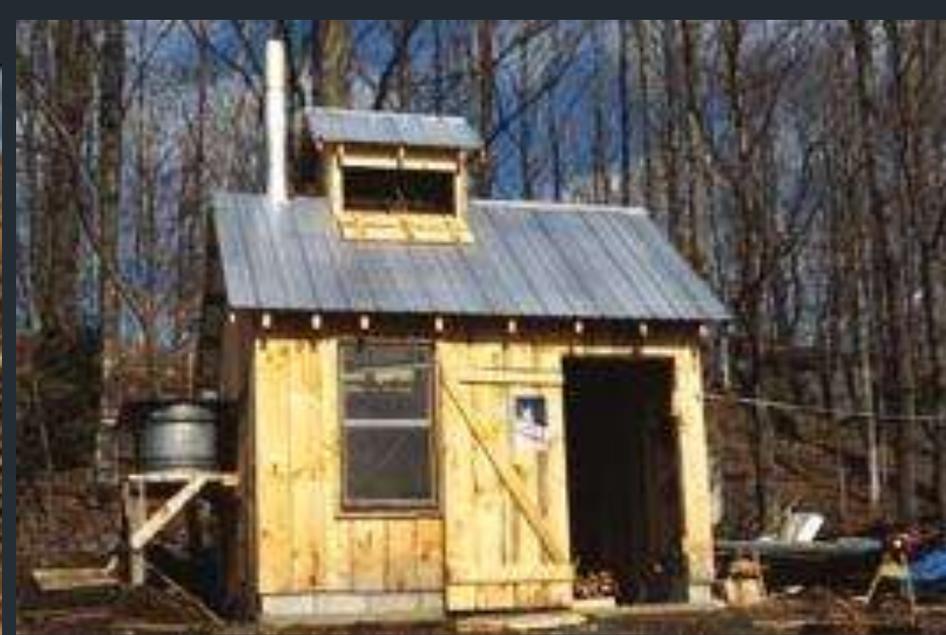


**FUN but,  
There's gotta  
be a better  
way!**



# The building...

- Foundation
- Drainage
- Concrete
- Electricity ?
- Water ?
- Accessibility
- Convenience
- Look around
- Ask questions
- Take measurements
- Photos





# Evaporating/Boiling Equipment



# Buying an Evaporator

- Equipment not included with evaporator:
  - High temp bricks & mortar
  - Candy or kitchen thermometer
  - Hydrometer & cup
  - Pails
  - Scoop, skimmer
  - Grading kit





# Evaporators (2017)

- A peek at prices
- Small unit, flat pans: \$1,500 - \$2,500
- 2' x 4': \$3,000 & up; 2 x 6: \$4,000 – 6,000+
- Brick & Cement: \$250 - \$300
- Also need:
  - Stovepipe, fittings, piping, skimmer, dipper, hydrometer, thermometer, strainer, grading kit, containers, firing gloves, pails.
  - All sap/syrup handling/storage containers to be intended for food.
  - Garbage cans - **NEVER** intended for FOOD.

# What Size?

- Never big enough – plan for expansion
- Room around evaporator
- Cupola – at least as many square feet as pans' surface
  - So...2 x 6 rig needs 12 square feet at cupola, minimum

# FAQs

- How many taps?
- How many gallons of sap?
- How much time to spend boiling?
- How many gallons can you evaporate per hour?
- Figure 1 + gallons sap per tap per day
- Start time... Quitting time???



# Basic Evaporators

- Evaporation Rates Vary
  - 5 to 8 gallons sap / hour; single pan
  - 15 to 20 gallons/hr. 2' x 4' rig
  - 25 to 30 gallons/ hr. 2' x 6' rig
  - Figure 100 taps = 100 gallons per day; 100 gall @ 20 gall/hr = 5 hours to boil.



# Evaporator Performance

- Basic rigs...
- ½ pint syrup per hour for small, flat pan rig
- 2 – 3 pints per hour for 2' x 4'
- 4 – 5 pints for 2' x 6'
- Maintain steady, hot fire to increase production rate



# Matching

- Sizing the Evaporator
  - 10 – 50 taps
    - Single pan, ½ pint, etc.
  - 50 – 300
    - 2' x 4', 2' x 6'
  - 300 +
    - 2' x 6' or larger
- Contact manufacturers for recommendations



# The Arch

- Height ? Think of your back.
- Line with Firebrick
- 6" or larger stovepipe
- Double walled for pipe passing through walls or ceiling
- Stack – 3 x pan length
  - 2' above roof line



# more Arch

- Level the arch
  - Initially
  - Recheck often



- Grates
  - Position with open end of Vs facing up.

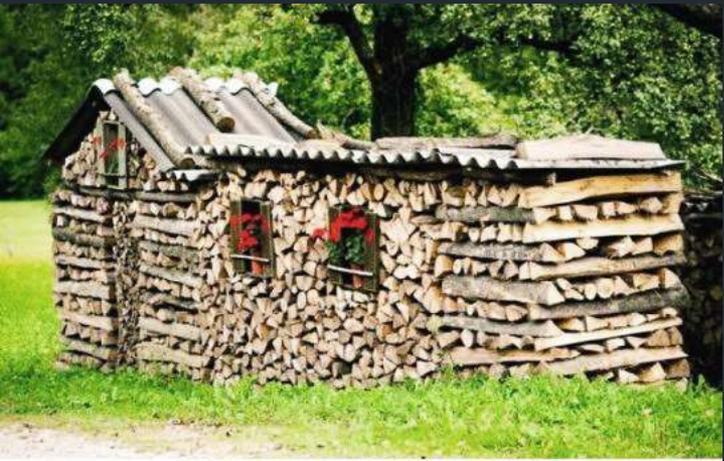


# Fuels

## Firewood

- Mixed hard & soft wood
- 16" – 20" length for small evaporator
- Know your firebox
- 2" – 3" diameter
- Combination split & round wood
- Cut a year ahead





People  
with TOO  
much time  
on their  
hands



# Other Fuels



■ Wood Chips



■ Propane



■ Fuel Oil



■ Wood Pellets





Boiling  
Finishing  
Packing  
Marketing

# Getting Ready

- AGAIN...Level the Evaporator
  - L to R & F to B
- Flood with sap
  - Ensure ample supply
  - All valves “ON”?
- Newspaper & kindling wood
- Do **NOT** use gasoline or other accelerants



# Firing Up

## Firing

- Firing/welding gloves
- Leave 3" – 4" space end of wood to door
  - of wood to door
- Too long can damage pans
- Criss-cross pattern
- Leave plenty airspace
- Open/Shut doors quickly



# Running the Evaporator

- Set draft door & damper
- Monitor & maintain sap level during boiling
- Fire every 7 – 8 minutes
  - Egg timer handy



# Running the Evaporator

## ■ Recommendations

- Flooding depth: 1 ½”
- Boiling depth: ¾” – 1”
- De-foamer: 1 drop/pinch every 10 minutes or each firing
- Switch sides daily
- Shutting down: I switch to soft-wood last few firings, fewer hot coals remaining
- Leave 2” or so in pans, get to know your rig, how much is enough?



# Improving Efficiency

Small fan at  
draft/ash door  
will improve  
boiling rate...

Steady, **hot**  
fire

*"Best \$16  
ever spent!"*



# Defoamers

- FRESHNESS COUNTS
- Vegetable oils
- Commercial defoamer – both liquid and solid
- Dairy products ???
  - milk, cream, butter allergies
- Do NOT over do it.
- Never use spray bottle.



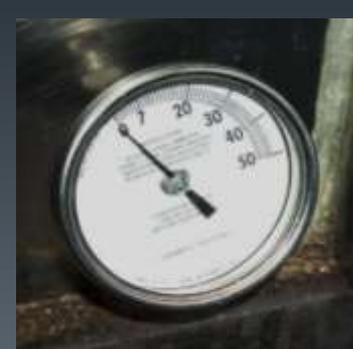
# Periodic maintenance

- Maintenance
  - Clean out ashes regularly
  - Clean pans as needed
  - Switch sides often
  - Repairs



# Is it Syrup yet?

- Temperature:  $7 \frac{1}{2}^{\circ}$  F above boiling point of water – check thermometer daily.
- Hydrometer:
  - $32^{\circ}$  Baume or  $59.9^{\circ}$  Brix
- Measure hot: right off evaporator



# Filtering/Straining



- Filter / strain **HOT**... immediately off evaporator
- Pre-filters very beneficial
- Check filters for thin areas
- Boil new filters 2X before use
- Clean daily, **do not** wring
- Sniff test – store dry, paper bag in drawer
  - Never in damp, musty area
  - Never near moth-balls



- Use new, accurate kit
  - old kits lighten
- Have old kit checked
- “Equal to or lighter than” minimum color
- Sky or fluorescent light

## Grading Syrup



# Syrup Standards

- Density



- Color



- Clarity



- Flavor





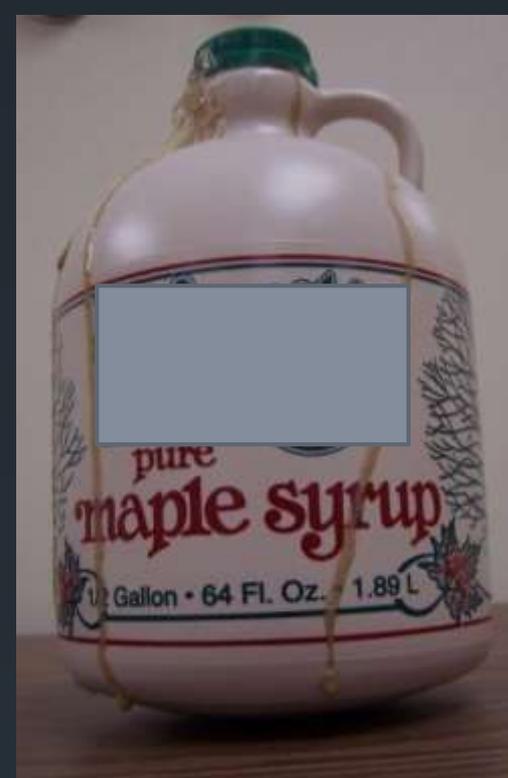
# Bottling, Canning Syrup

- Hot pack: 180 - 190° F
- Cap it
- Lay container on side - 10 minutes, then stand, let cool
- New, clean containers
- Keep coded sample bottle of each batch
- Code each container



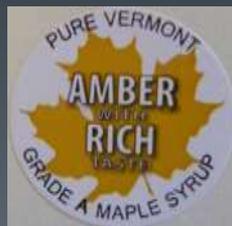
# Syrup Storage

- Cool before storing
- Store in cool area
- Freeze, if room available
- Low density syrup will spoil, ferment
- Heavy density syrup will crystallize



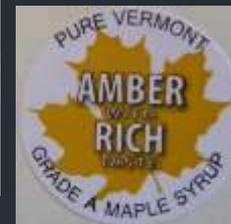
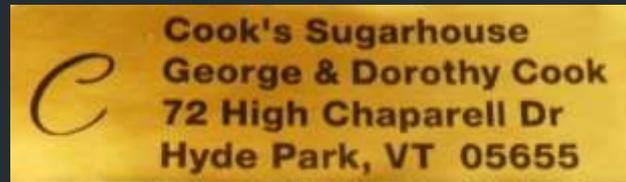
# Vermont Maple Syrup Grades

- **1900s thru 1982**
  - Fancy - A - B - C - Substandard
- **1982 thru 1993**
  - Fancy - Grade A Medium Amber - Grade A Dark Amber - Commercial - Substandard
- **1993 thru 2014**
  - Fancy - Grade A Medium Amber - Grade A Dark Amber - VT Grade B - Commercial - Substandard
- **2014-2016 (transition) on... No. Am. Maple Syrup Grades**
  - Grade A Golden/Delicate (VT Fancy) - Grade A Amber/Rich - Grade A Dark/Robust - Grade A Very Dark/Strong - Substandard



# Selling / Marketing

- Vermont Labeling Requires:
- Product & Amount
- Your Name
- Address
- Grade A...
  - Golden/Delicate “VT Fancy”
  - Amber/Rich
  - Dark/Robust
  - Very Dark/Strong
- Code each container
- Charge a realistic price ... cover your costs ... make a profit ...



# Displays – Exhibits

- Put Your Best Foot Forward
- Attractive Display, Clean, Neat
- Samples? Taste them daily



# Entering Syrup to Win

- Entering a contest?
- Do everything a judge would do:
  - Open it
  - Check the Density
  - Check the Clarity
  - Check the Color
  - TASTE it!
- Now...Would you want someone else tasting this syrup?
- Sugarmakers with the best intensions have **RUINED** their syrup.
- Never place it in used containers:
  - No Pickle Jars
  - No Peanut Butter Jars
  - No Mayonnaise Jars
  - Best in new, rinsed canning jars
  - This means new lids, too!

# End of Season Clean Up

- **HOT WATER** – the magic ingredient, soft water best
- Pan cleansers – neutralize & triple rinse when used
- Stiff bristle brush, avoid scratching equipment
- No soap, detergent, any scented material
  - Syrup is very sensitive and will pick up other flavors



# Cleaning your Evaporator

- Fill pans with water; distilled if available, it's mineral-free.
- Add cleaner – Carefully!
- Boil 1 hour or until scale is loose, flakes off
- Stiff bristled nylon brush
- Avoid harsh abrasive pads or steel wool



# After Sugaring

- Clean pans, equipment
- Pull spouts, clean lines
- Cover pans with plywood, tarp or plastic to keep out squirrels, mice, bats & debris



# Bells & Whistles ~ wish-list

■ Many efficiency enhancing products available:

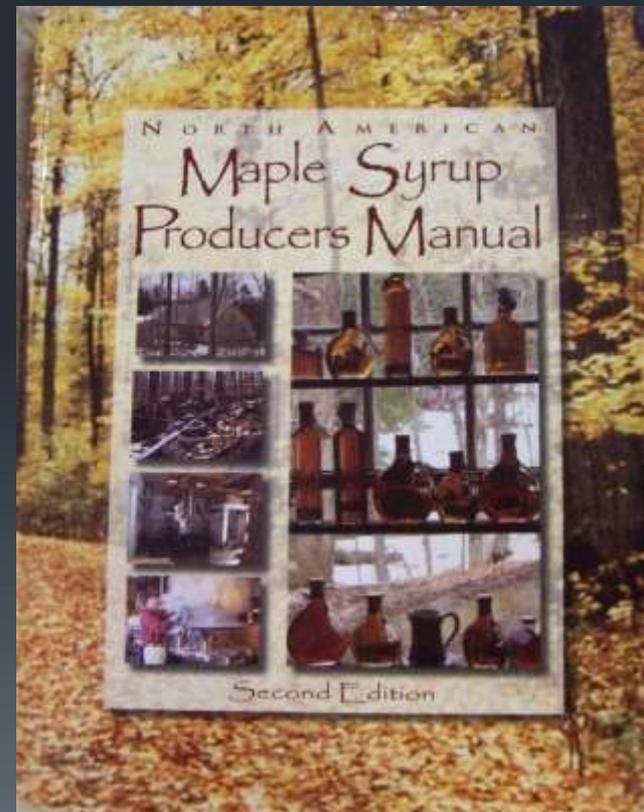
- Steam hoods
- RO
- Forced Draft
- Vacuum
- High efficiency oil burners
- New tubing systems
- Quick-connect couplings for tubing
- Canning units
- ...



# Looking for Info...

- [George.cook@uvm.edu](mailto:George.cook@uvm.edu)
- Toll-free 866-260-5603
- or
- [Mark.isselhardt@uvm.edu](mailto:Mark.isselhardt@uvm.edu)
- 802-899-4923
- or
- [www.uvm.edu/~uvmapple](http://www.uvm.edu/~uvmapple)

- VMSMA at
  - [www.vtmaple.org](http://www.vtmaple.org)
- UVM PMREC at
  - [www.uvm.edu/~pmrc](http://www.uvm.edu/~pmrc)
- Maple Manual
- Sugarmakers



Questions?

# All too common Off Flavors

- Buddy
- Metabolism
- Ferment
- Metallic
- Defoamer
- Musty/Moldy
- Chlorine
- Detergent/Soapy
- Burnt Niter
- Scorch
- Filters/ New Filters
- Chemical