Heat Treatment Considerations
Before, During & After

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History of Heat

Early 1900’s
Gaining Popularity
Considerations Evolving
Heat Treatment

- 120°F. to 140°F. Target Zone
- Lower Humidity Likely
  - As temperature increases, humidity decreases.
- Lethal Target Zone for Insects
## Temperature Insect Response

<table>
<thead>
<tr>
<th>Zone</th>
<th>Temperature</th>
<th>Insect Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lethal</td>
<td>120°F to 140°F</td>
<td>Death in minutes</td>
</tr>
<tr>
<td></td>
<td>110°F to 115°F</td>
<td>Death in hours</td>
</tr>
<tr>
<td>Sub-optimum</td>
<td>95°F to 100°F</td>
<td>Development stops</td>
</tr>
<tr>
<td>Optimum</td>
<td>75°F to 90°F</td>
<td>Maximum development</td>
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<tr>
<td>Sub-optimum</td>
<td>65°F to 70°F</td>
<td>Development slows</td>
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<td>55°F to 60°F</td>
<td>Development stops</td>
</tr>
<tr>
<td>Lethal</td>
<td>35°F to 45°F</td>
<td>Death in weeks</td>
</tr>
<tr>
<td></td>
<td>-5°F to 10°F</td>
<td>Most S.P.I’s die</td>
</tr>
<tr>
<td></td>
<td>-20°F to -10°F</td>
<td>Death in minutes, insects freeze</td>
</tr>
</tbody>
</table>
Heat Sterilization

- 160°F ++++
- Quicker Insect Kill
- Microbial Reduction
- Harder on Equipment & Structures
Heat Treatment Duration

- When temperature reaches 125°F. + for 2 hours, the mission has been accomplished.
  - Ambient, internal or external ???
    » Wherever the insect is at.

- Typical **structural** heat treatment duration
  - Set up & heat up (8 – 12 hours)
  - Hold temperature (24 – 36 hours)
  - Cool down (< 8 – 12 hours)
Heat Treatment Duration

- When temperature reaches 125°F. + for 2 hours, the mission has been accomplished.
  - Ambient, internal or external ???
  » Wherever the insect is at.

- Typical **equipment** heat treatment duration
  - Set up & heat up (4 - 6 hours)
  - Hold temperature (8 - 16 hours)
  - Cool down (< 4 - 6 hours)
Heat Treatment Duration

- When temperature reaches 125°F. + for 2 hours, the mission has been accomplished.
  - Wherever the insect is at.
  - Time is not as important as the temperature.

- Inside the walls
- Inside the equipment
- Inside the bins

Know your temperatures.
Facility Preparation For Heat Treatment
Old Myths or Half Truths

- Heat not successful because floor level temperatures are not high enough.
- Cannot heat entire facility at once, so partial treatments are not successful.
- Heat will burn down my place.
- Heat will dry out my wood equipment.
Old Myths or Half Truths

- No such thing as one checklist for all HTs.
- No need to learn from others.
- It takes three HTs to get it right.
- No two heat treatments are alike.
  - Different facilities
  - Different geographical locations
  - Different weather
- No need to involve other departments.
Develop A Multi-Functional Heat Team

- CHAIRED BY THE “SPENDER”
- CORPORATE SUPPORT
- SANITATION
- ELECTRICIANS
- PIPE FITTERS
- MILLWRIGHTS
- PEST CONTROL SERVICE PROVIDER
  – OWNERSHIP FROM ALL DISCIPLINES!
Facility Preparation For Heat Treatment

conduct progress meetings

- The “P” Lesson
- Planning, Preparation & Practice Prevents A Pitiful Performance

“Third Time Is Usually A Charm”
- Effective
- Efficient
- And Economical
Effects On Sprinkler System

- High temperature sprinkler heads should be specified for areas which will be heated.
  - High temperature heads (286 degrees F) should be used because hot spots do develop that will prevent the accidental water release by one of the sprinkler heads.
  - Medium temperature heads (200 degrees F) will work with excellent air movement.
  - Low temperature heads (160 degrees F) are not recommended.
Effects On Controllers And Electrical Equipment

- Identify Control & Equipment Concerns
- Contact Manufacturer Supplier
  - Describe a Scenario
    - 120 to 140 Degrees F for 12 to 24 Hours
  - Use your vendors as a resource
- Moving Air Will Minimize Damage While Improving Effectiveness.
THERMAL SHOCK

90 Degree F. differential rule of thumb
Heat Effects On Equipment Lubrication

Gear Boxes -
The air (and the oil) in the gear box will expand when heated. If expanded, warm air can escape through the breather, there will be no problem. If there is no breather, pressure inside the gear box may force the lubricant out of the seals. Or, if the gear box is full of oil, it will also expand, spill or be forced through seals.
Building & Equipment
Heat Losses

- Close and/or seal fire doors, man doors, roof vents, wall vents, and windows.
- Areas which are not to be included must be partitioned off if the area cannot be isolated—tarps and plastic can be used as makeshift walls.
- Exhaust and intake vents should be closed.
  - Keep functional for temperature control.
Preparation Specific To You Facility

- Prior to Heat-up
  - Develop guidelines and your checklist
- During Heat-up
  - Develop guidelines and your checklist
- After Heat-up
  - Develop guidelines and your checklist
Heat Treatment Considerations
Before

Planning Team
- determine “what” to heat with “what”, and “when” monitored by “who”
- start a couple of months prior to a heat up
- identify concerns for investigation & action
  » check with suppliers
    • get answers, make sure, do small tests
Heat Treatment Considerations
Before

- Equipment considerations
  - sprinkler heads, fire protection system
  - sensitive electrical
    » computers
  - belt drives
  - lubricants
  - wood sifters
Heat Treatment Considerations Before

- Removal of certain items
  - aerosol cans / pressured cylinders
  - fire extinguishers
  - sensitive ingredients, vitamins
  - packaging materials
  - portable computers
  - contractor materials

- A pre-heat walk through should identify any items of concern listed above.

» A Must Do!
Heat Treatment Considerations

Before

- Remove most food products
  “The performance characteristic of the food will likely change when exposed to these temperatures and time. Wheat does not mill as well. Flour does not bake as well and we know what happens to chocolate.”

- Things do dry out!
Additional Pre-heat Preparation

- Run equipment and bins, silos, etc. empty.
- Elevator Boots opened and cleaned.
- All sweepings and trash receptacles cleaned.
- Sacks of product removed.
- Portable containers emptied.
- Open as much processing equipment as possible - dust collectors, bins, hammer mills, feeders, screw conveyors, etc.
Heat Treatment Considerations
Before

- Preparation immediate to a heat up
- cleaning
- seal building
- insecticide residual application
- placing air circulators and heaters
- placing thermometers and hygrometers
- placing insect test cages
- placard warning on entry doors
WARNING

HEAT STRESS AREA
Heat Treatment

Hot Air Is Available From Many Sources
Heat Treatment Sources

- Electric
  - Excellent for smaller treatment areas.

- Propane/Gas-fired
  - Excellent for large structural applications.

- Steam Heat
  - If boiler capacity is sufficient, excellent for large and small applications.
  - If boiler capacity is small, good for smaller treatment areas and a good to supplement other applications.
Heat Treatment Considerations During

Worker Safety Provisions
- clothing, no metal
  » buttons, glasses, etc.
- established routes with flashlights
- rest area with first aid, emergency phone numbers
- cool vests available for emergencies

Monitoring, adjusting heaters, fans and reporting activities are necessary
Heat Treatment Considerations During

- Monitoring during a heat treatment
  - Buddy system - pairs
    » *Keep an eye on the place AND each other.*
  - Data collection
    » Temperature and Humidity
      • Remote minimizes time in the heat
    » Insect mortality
Buddy System
Heat Treatment Considerations

After

- Cool down
- Collection of monitoring equipment
- Operational start up
  - Process flush out … insect fragments may be high
- Look for
  - plastic material sagging
  - leaks – lubricants, seals
  - peeling of old paint
  - dead insect accumulations lead to unknown sources

Document for Future Reference
Resources

- Internal

- Outside Services
  - “Think Outside The Box”
Why heat treat 3 million cubic feet, if the insect problem is only in 3 thousand cubic feet?
Heat Treatment Considerations

Rule of the “E’s”

– 1. Experiment and Learn

– 2. Become Effective and Efficacious

– 3. Become Efficient and Economical
A Heat Treatment Profile
Average temperature by floor

Lethal Duration
Is there a temperature difference inside equipment during a heat treatment?

A slight difference and a cool down delay does exist.
A Heat Treatment Experiment
Average temperature inside and outside sifters

- Inside
- Outside

<table>
<thead>
<tr>
<th>Temperature (Deg. F)</th>
<th>6:00 PM</th>
<th>5:00 AM</th>
<th>12:00 PM</th>
<th>4:00 PM</th>
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Heat Treatment Experiment
Flour Beetle Mortality
Inside sifters
Heat Treatment Experiment
Flour Beetle Mortality
Inside Sifters

- 8 Hours: 33% Live, 67% Dead
- 12 Hours: 0% Live, 100% Dead
- 16 Hours: 0% Live, 100% Dead
Heat Treatment Considerations

Summary

- Heat is Effective!
- Heat Supports IPM!
- Heat is a Back to Future Concept!
- Be Prepared!

- Better Than Some Alternatives =>
Maybe

Are there any other questions?

Are We Done Yet?