HOT AIR

YOUR GREEN ALTERNATIVE

Sixth Heat Treatment Workshop
A Practical Methyl Bromide Alternative for 2009 and Beyond
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THERMAL REMEDIATION FROM TEMPAIR

Presentation Outline

THERMAL REMEDIATION FROM TEMPAIR

Heat Treatment – Historical Look

- 1762, France: 69°C / 156 °F for 3 d, moth
- 1860, England: 57°C / 135 °F for grain
- 1910, USA: heat treatment of mills
- 1920, USA: 30 mills use heat in OH, PA
- 1932, France: MB as insecticide

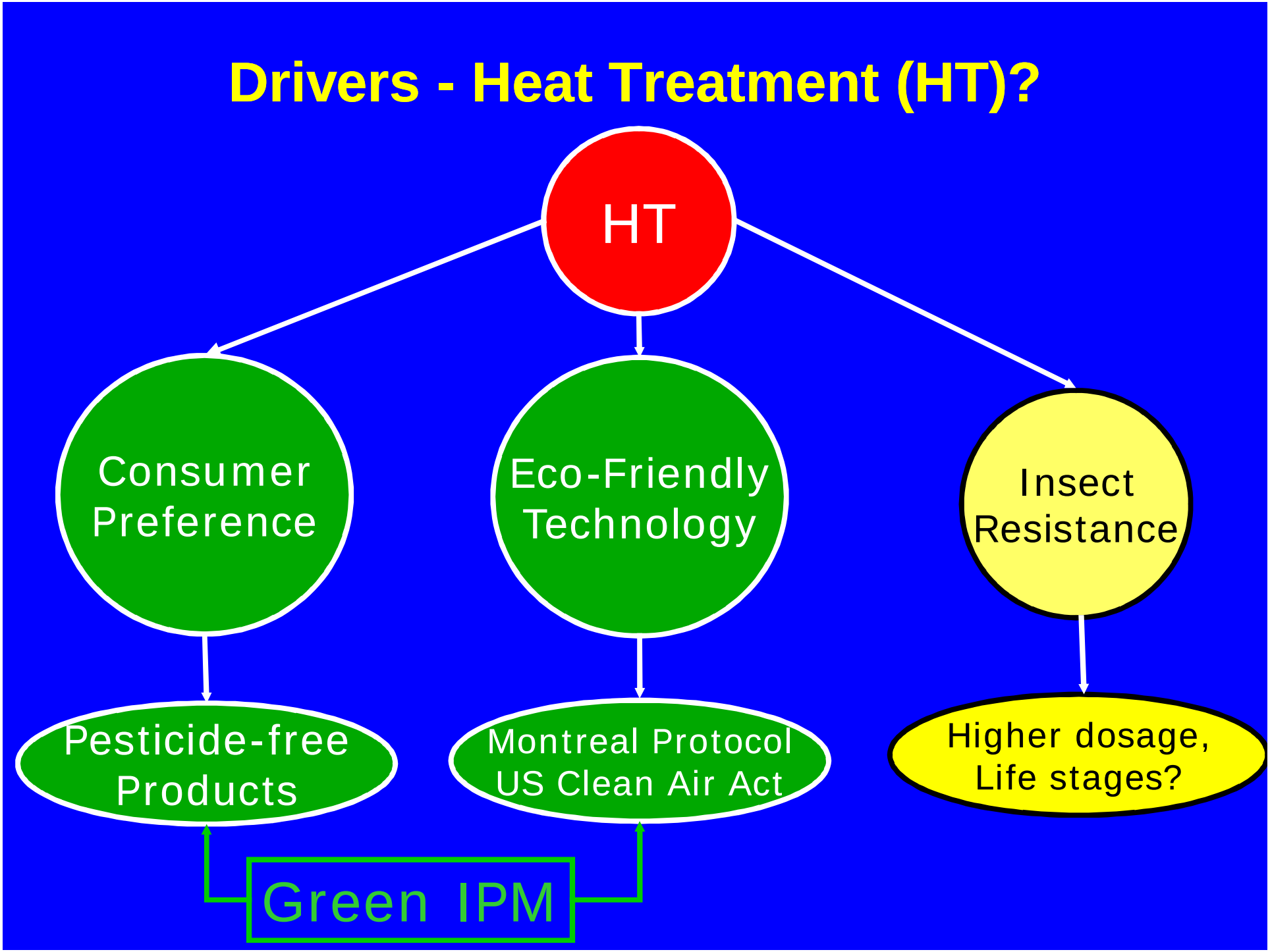
Used first 247 yrs ago!

History of Heat Treatments

- 1950's: Quaker Oats using heat
- 1983: EDB banned
- 1990's: increased interest in heat
- 1992: MB found ozone unfriendly
- 1994: Dursban in Cheerios
- 2005: MB to be phased out
- 2006: MB extension US, Canada ???

Source: P. Fields, AAFC, Canada

Drivers - Heat Treatment (HT)?



Heat Advantages

- **S**afe: non-chemical, people-safe
- **E**ffective: kills all life stages
- **E**co-friendly: no ozone depletion, toxic fumes, or corrosive effect

Heat treat: Facilities, Bins & Silos

THERMAL REMEDIATION FROM TEMPAIR

Heat Advantages

SEE → **Safe**

SEE → **Effective**

SEE → **Eco-friendly**

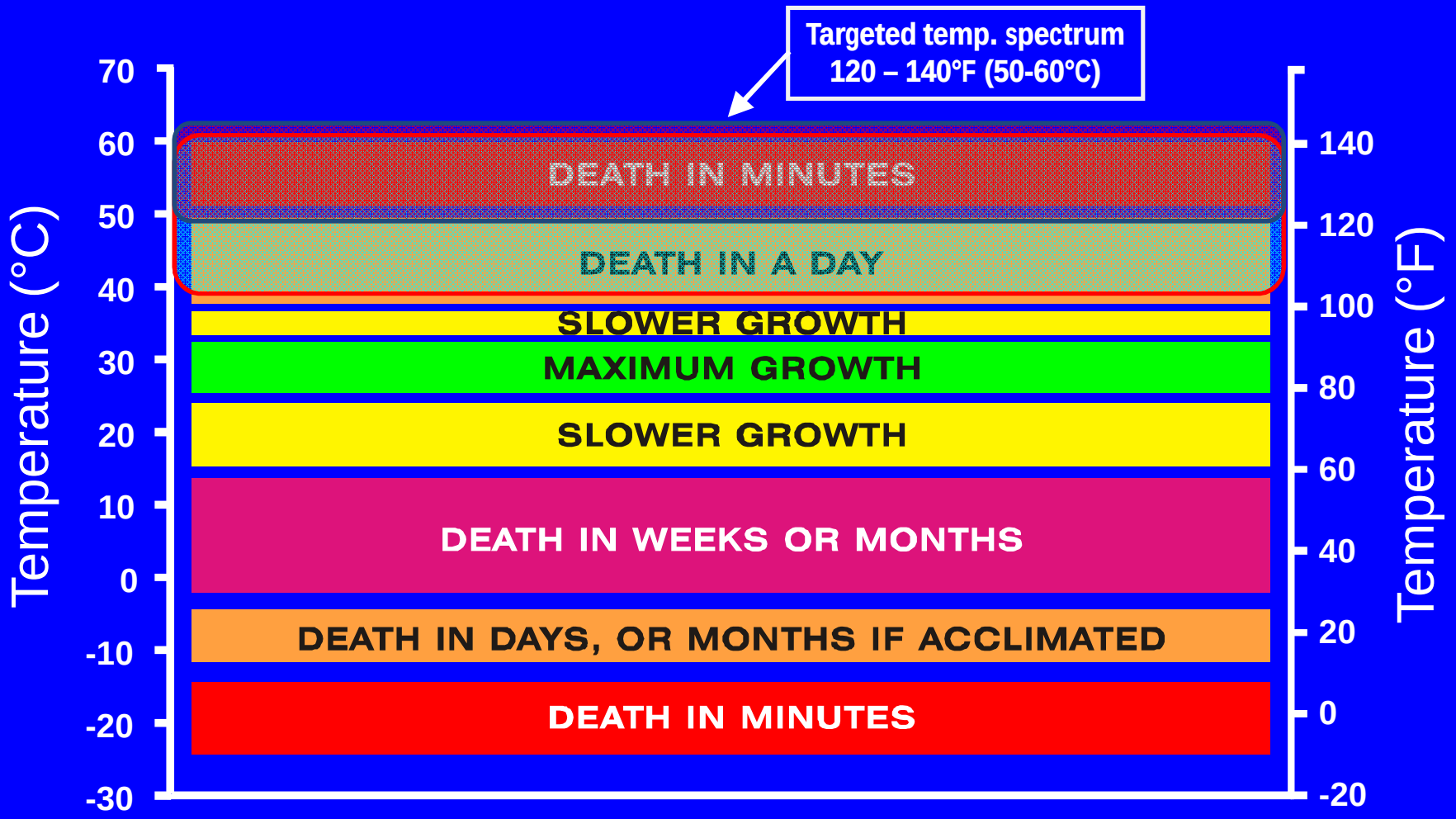
- No evacuation of personnel
- No Sealing (except doorways, loading docks etc.)
- Spot Treatments – continued productivity within plant, offices, warehouse etc.

THERMAL REMEDIATION FROM TEMPAIR

Heat & Insect Death

- High temperature –
  - Death by Dehydration (low RH)/desiccation
- Above 50 °C / 120 °F
  - Cell membranes “melt”
  - Enzyme destruction
  - Change in salt balance
  - Protein coagulation

Temperature Effects on Insects



Source: P. Fields, AAFC, Canada

Efficacy to Control Pests

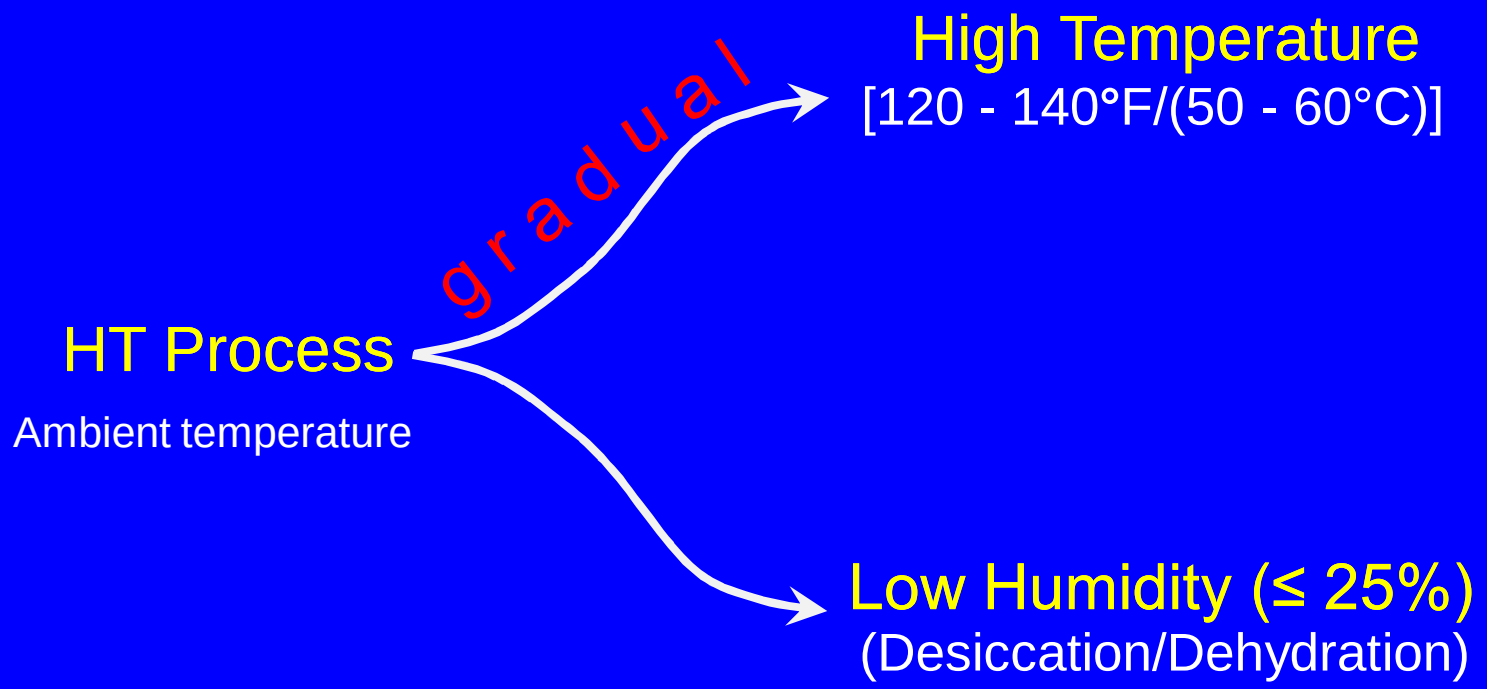
- MBr – Methyl bromide
- PH_3 - Phosphine
- SF (Profume)
- CO_2 – Carbon dioxide
- O_3 - Ozone

. . . . .

Efficacy – function of temperature

Heat Treatment

Insects – lethal threshold temperatures



Heat Vs MB - Downtime Comparison (hours)

Methyl Bromide

- Sealing.....0
- Set up.....4-6
- Fumigation.....24
- Aeration.....12-24
- TOTAL.....40-54

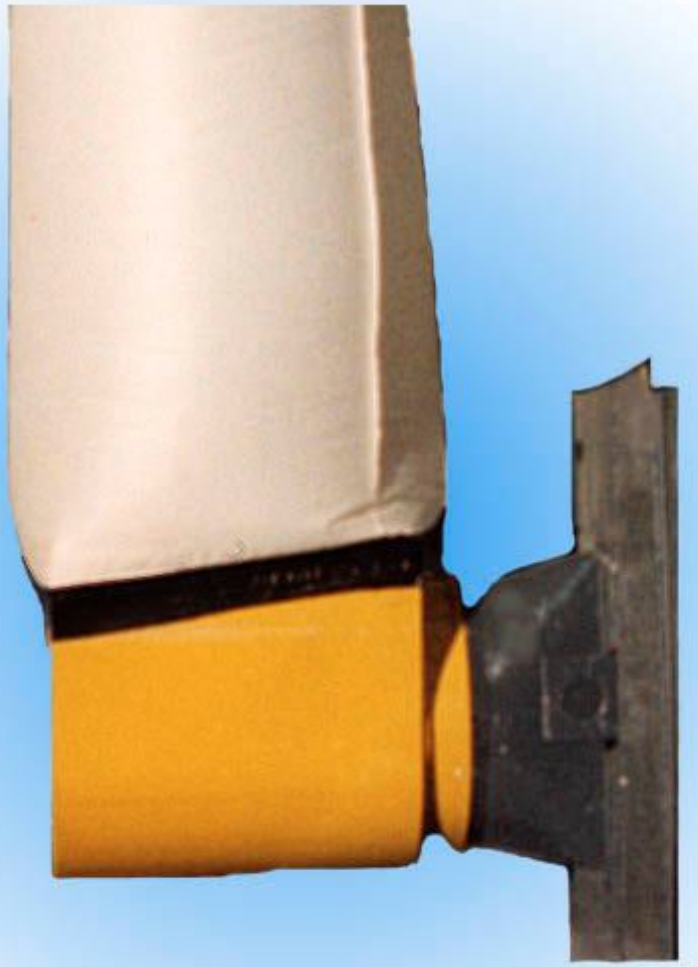
Plant evacuation mandatory

Thermal Remediation

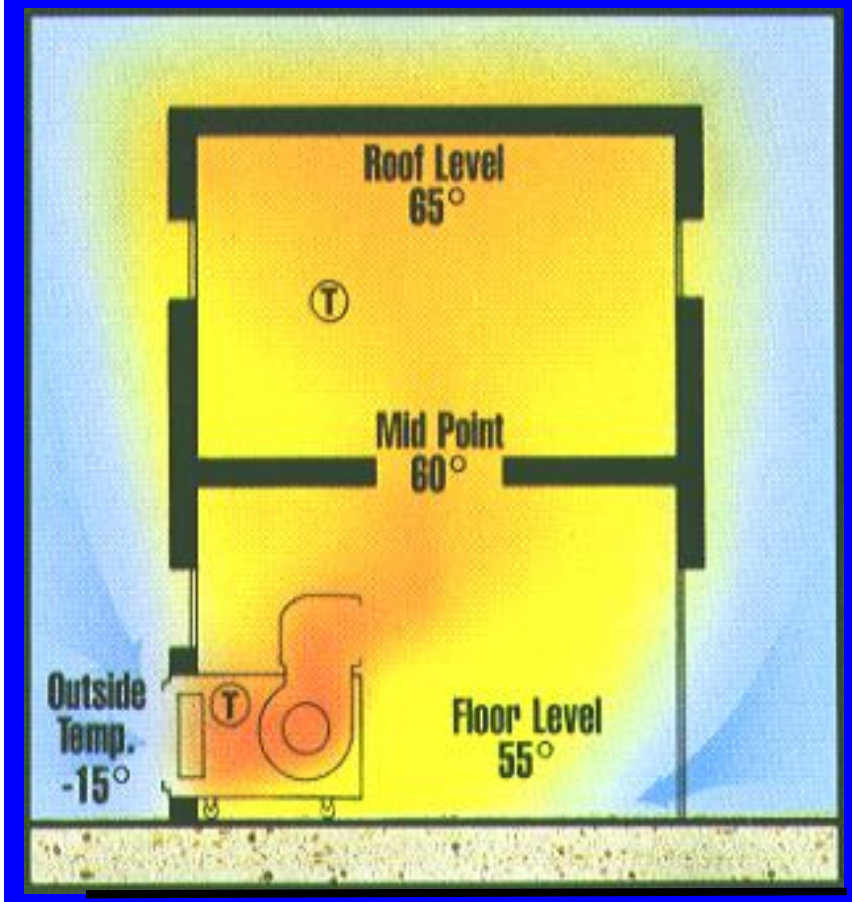
- Set up.....0
- Heat up.....6-8
- Kill Period.....24
- Cool down.....2-4
- Tear down.....1-2
- TOTAL.....33-40

Untreated areas operational

Process



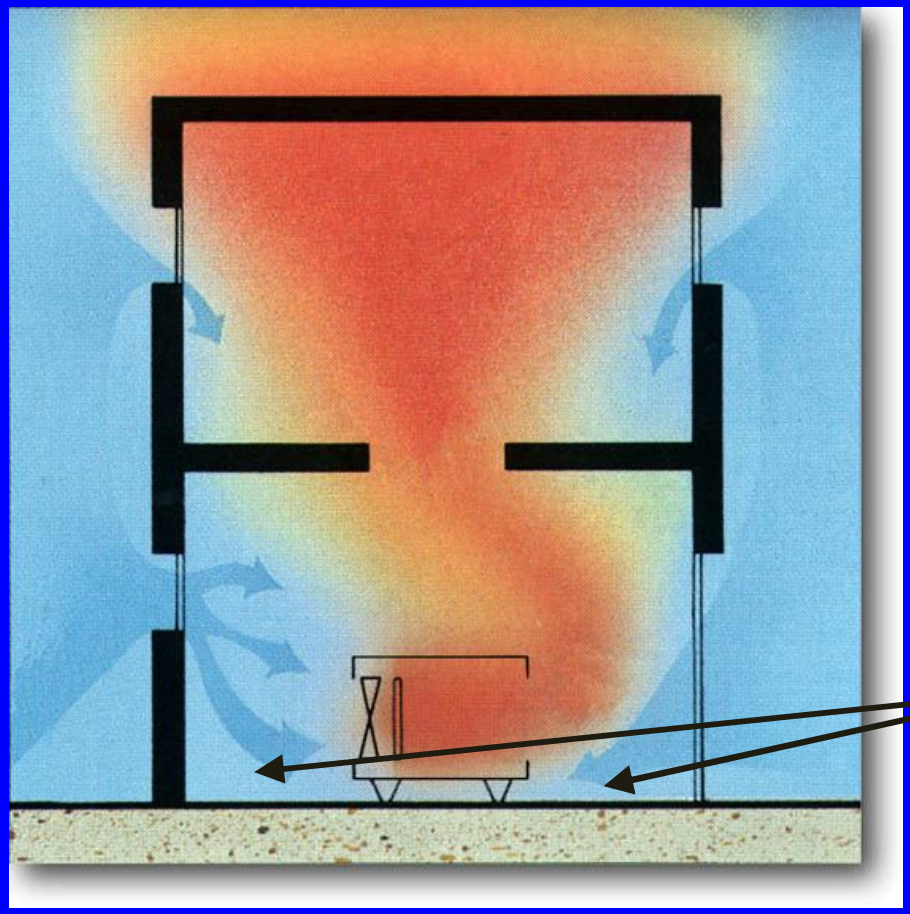
Positive Pressurization – Forced ambient air (Patented Process)



US & Canadian Patents

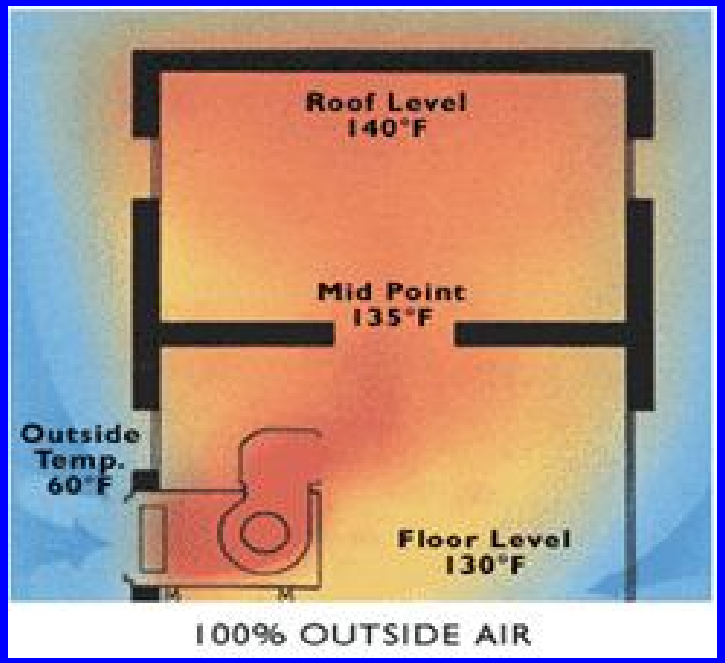
- Positive pressure
  - Good air distribution
  - Hot air is pushed into corners, cracks and crevices
- Calculated and controlled infiltration (4-6 air changes per hour)
- Lower relative humidity

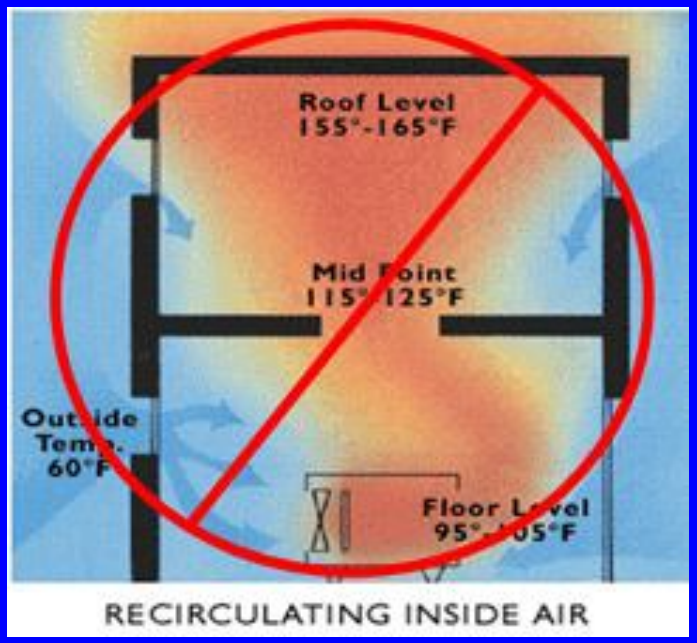
Re-circulating Inside Air



- **Negative pressure**
- **Poor air circulation**
- **Uncontrolled infiltration**
  - **No air changes**

Construction Heat Principles: Make-Up vs. Recirculating





- Recirculating heaters promote thermal stratification and infiltration
- Make-up air heaters provide uniform temperatures, pressurize the structure, and exhaust moisture and fumes

Steps in Heat Treatment

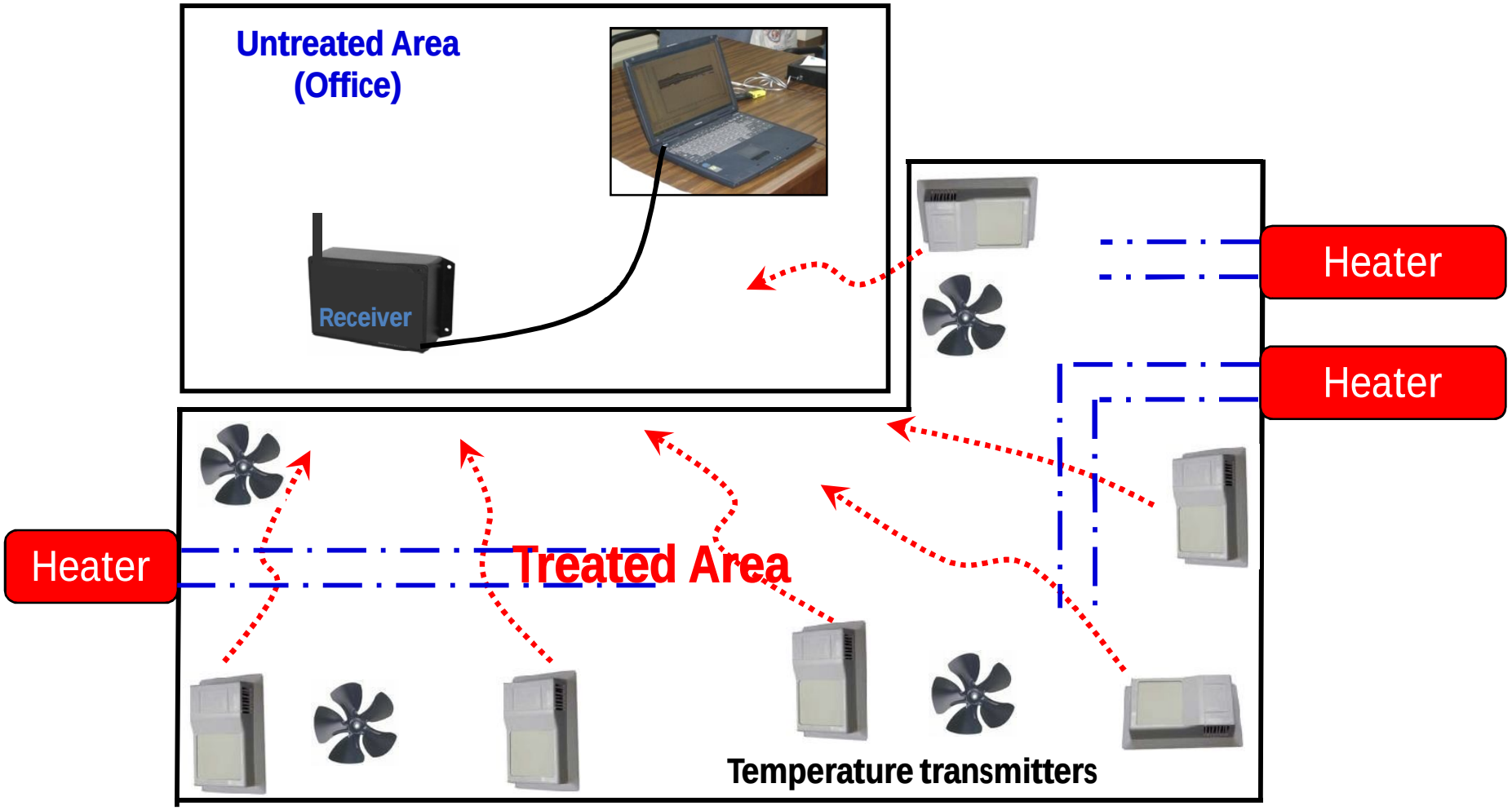
Visit & Feasibility

Engineering, Equipment & Estimate

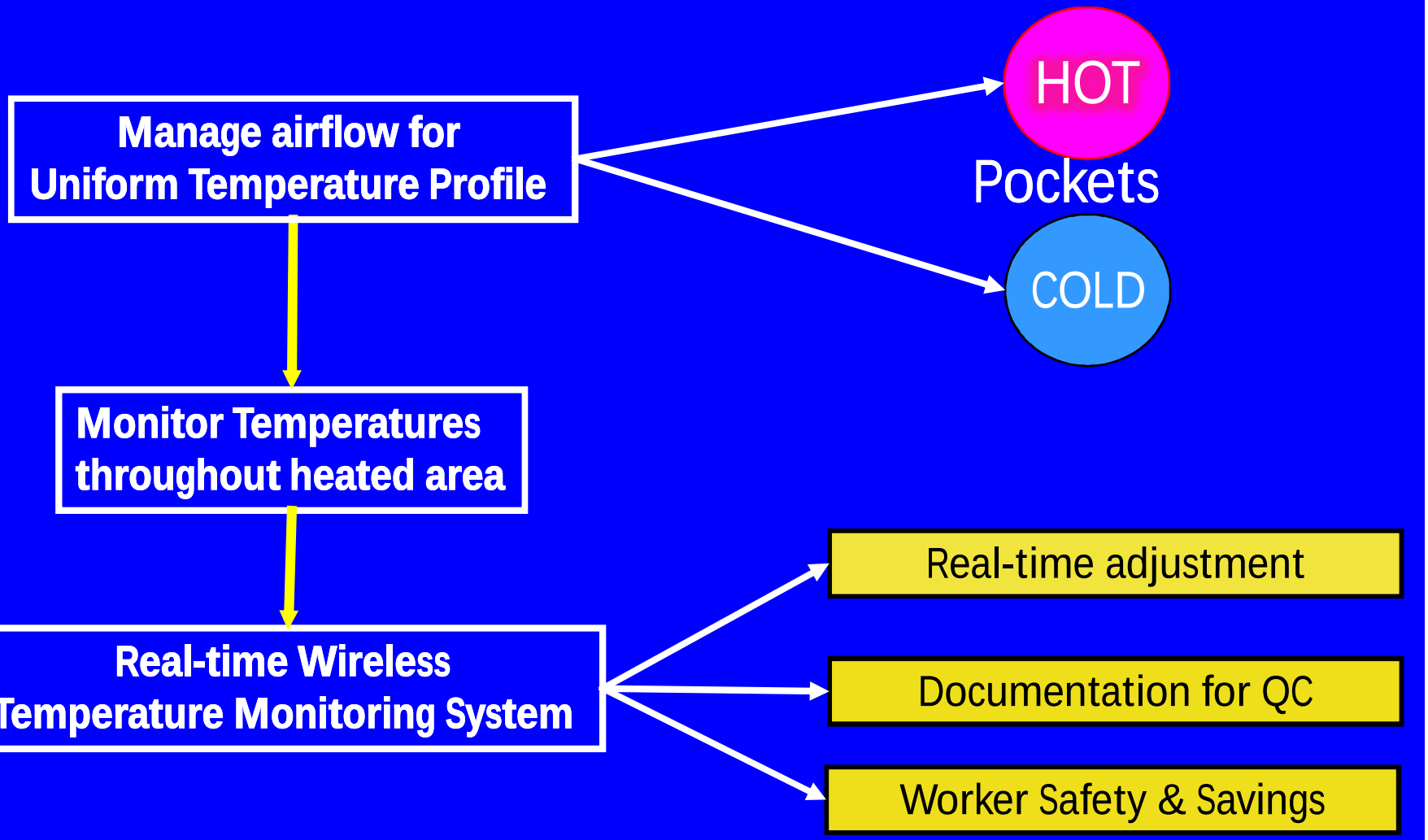
Equipment mobilization

Setup, HT, Document & Review

Real-time Wireless Temperature Monitoring



Effective Heat Treatment



Start of the Heat Treatment

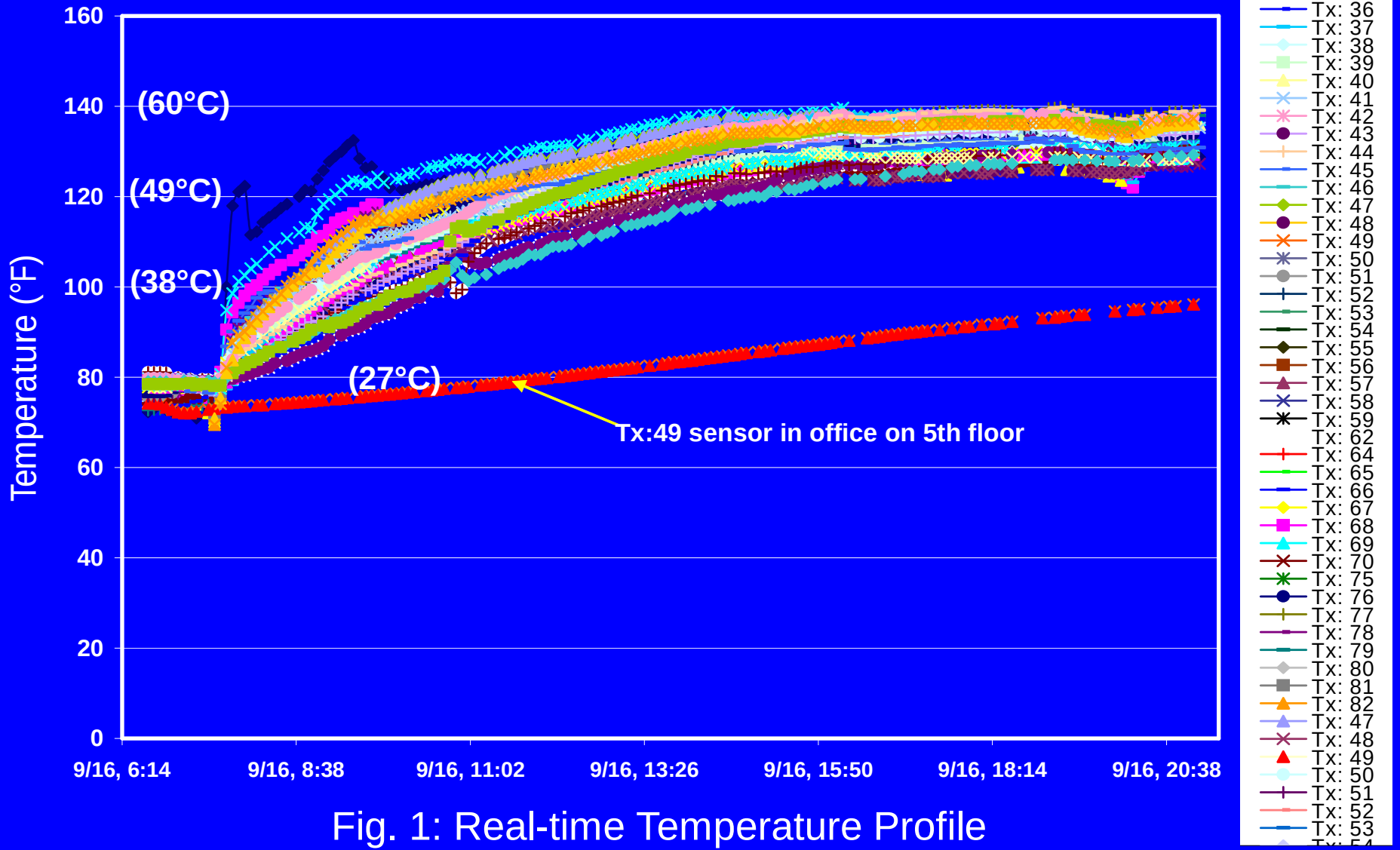


Fig. 1: Real-time Temperature Profile

End of the Heat Treatment

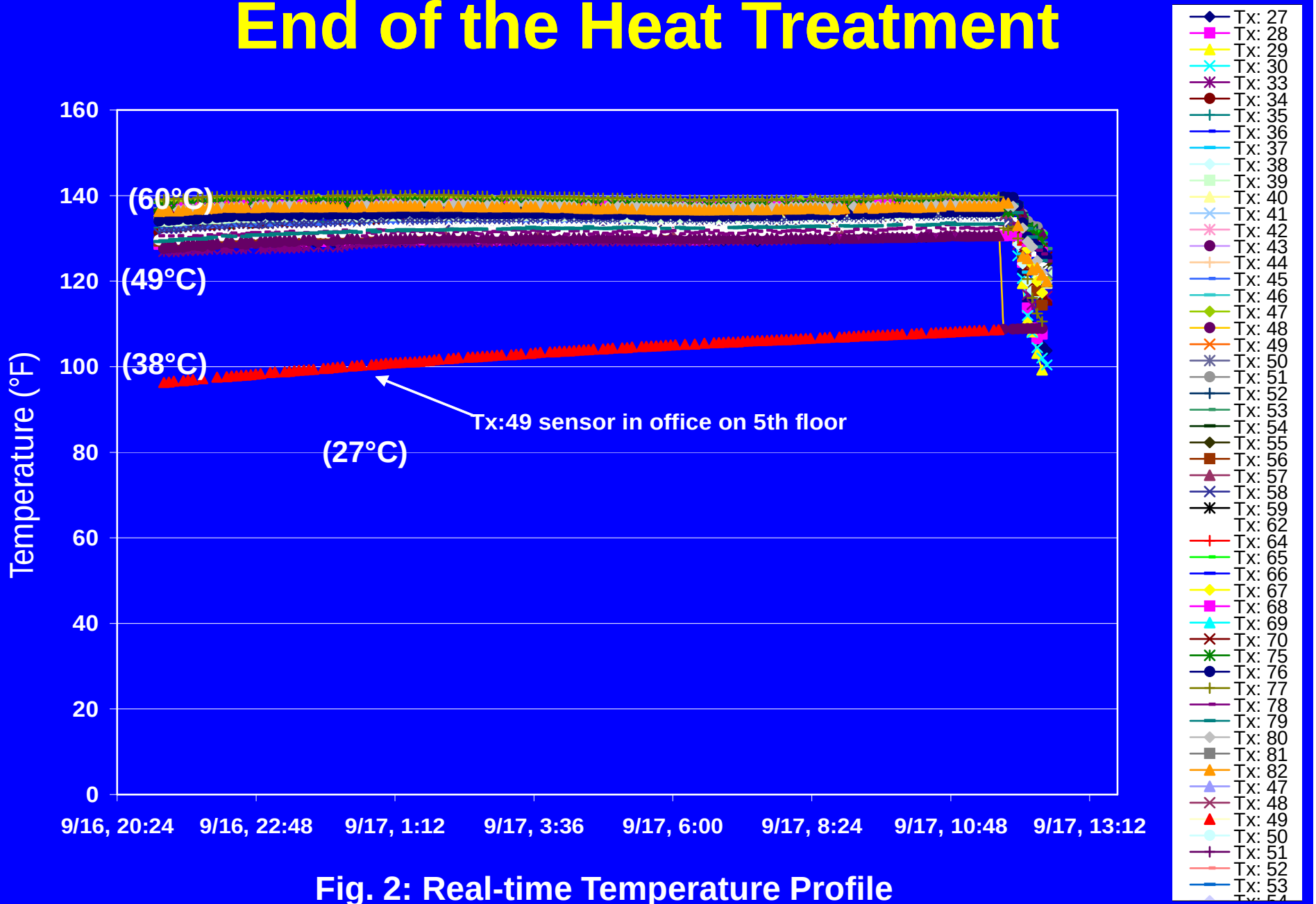


Fig. 2: Real-time Temperature Profile

Heating in Mill

Time (h)

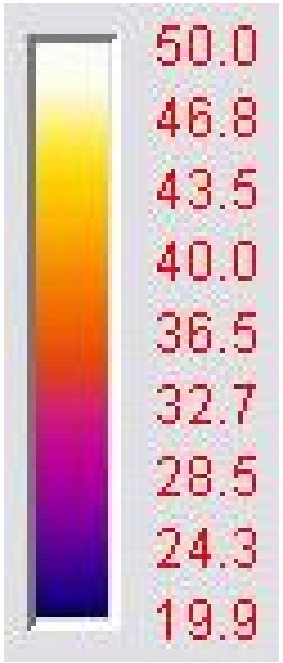
0

0

1

3

4.5



Spread of Heat Treatment

- USA
  - California, Indiana, Minnesota, Kansas, Dakotas, Arkansas, NJ, Florida, Wisconsin. . . ..
- Canada
  - Ontario, Manitoba, Alberta, Maritime provinces

THERMAL REMEDIATION
Industrial Applications

- Food Processing
- Rice Mills
- Flour Mills
- Pet Food
- Corn Mills
- Cereal Processing
- Bakeries
- Warehouses

- Pork Industry
- Baby Food
- Wood Packaging
- Finished Furniture
- Tobacco Companies
- Custom Cabinetry
- Hospitality / Hotels

Organic processing plants/storages

Entire structure or spot treatment

Heat Treatment of Bins & Silos

Proactive – Preventative

&

Reactive - Response

Bins & Silos

- Pre-loading or Pre-harvest HT
  - On-farm bins
  - Elevators storages
  - Processing facilities
  - Organic processing plants
- Bin/Silo types
  - Concrete
  - Metal
    - GI bins
    - Tanks

Empty Bin Sanitation

- Accumulation of BGFM under bin floors
  - Insect harborage
  - Mold spore accumulation
- Difficult to clean bin floors
- Available tools difficult to use or unavailable
  - Insecticide sprays have to drip through floor perforations
  - Blowing DE through fan does not guarantee uniform application
  - Chloropicrin no longer available
  - Phosphine requires applicator license

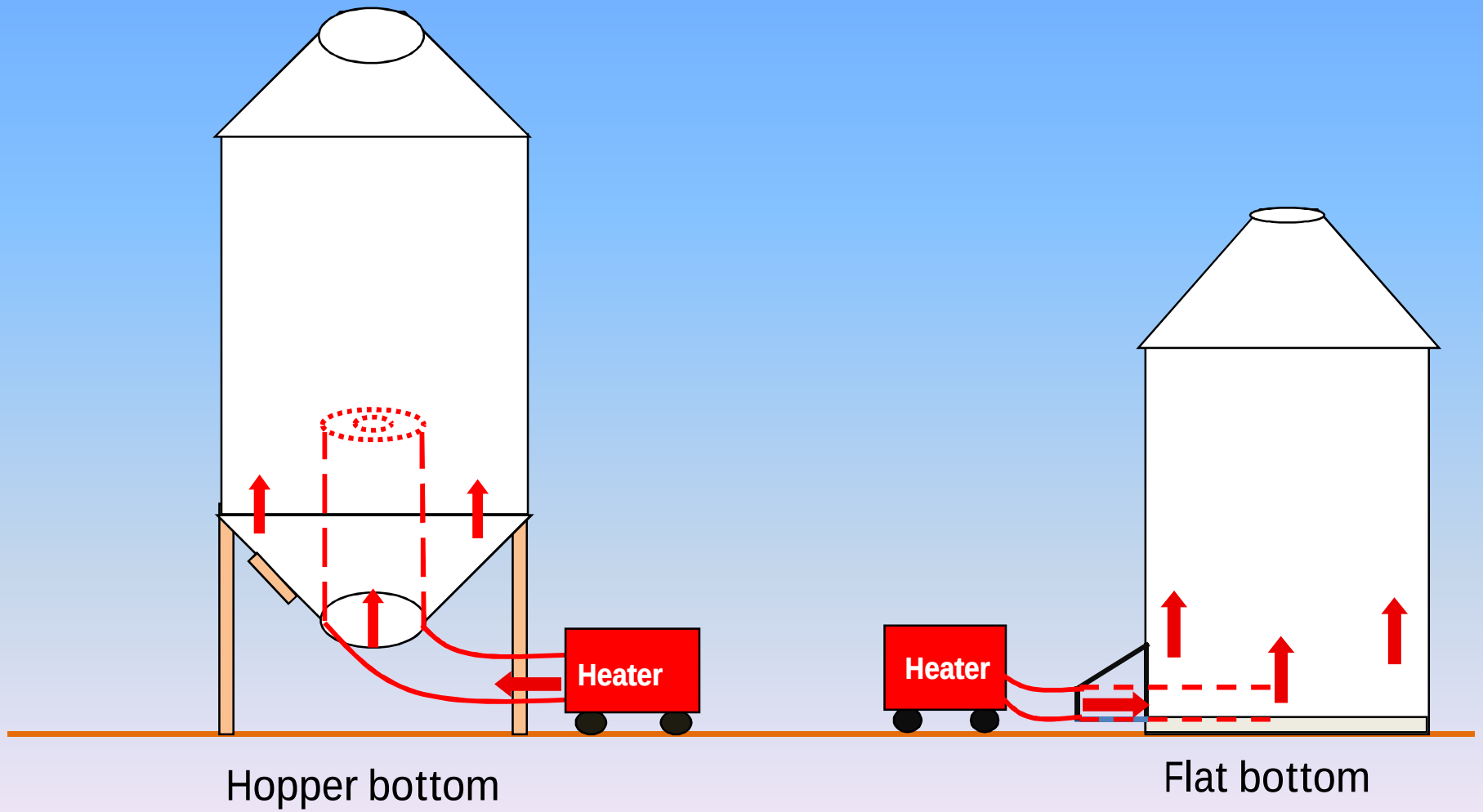
PERC Project – Purdue University
Heat Treatment of Bins & Silos

TEMP-AIR MHT-1500:

- Self contained mobile unit
- 7.5 Hp blower motor
- 30 KW, 230 V, 3 phase generator
- 150 gal. capacity LPG tank
- 1.5 million BTU/hr heater output

Portable Self Contained Unit
Mobility with Simplicity!

HT of bins and silos



Advantages of HT of Bins/Silos

- S E E
- Shorter treatment times (4 to 12 hours)
- Bins/Silos in facilities
  - Treated in rotation without shut-down
- On farm or warehouses – no extensive sealing or evacuation
- No retrofitting – existing transition, bin-entry

CAN YOU REDUCE IT?

-
-

CAN YOU REDUCE IT?

- Facility C – all adults/larvae of RFB dead at 50°C/122°F within 12 hours – Dr. Subi
- Facility X: 10- 12 hrs at 50 to 55°C/(122 - 131°F)
  - Adults: Drug store beetle, Tobacco beetle, RGB, RFB, CFB
  - Larvae: Drug store beetle, yellow meal worm

(Source: Dr. Paul Fields, AAFC, Canada)

- Predictive model: Thermal Death Kinetic model (Dr Subi)
- Smaller areas – bakeries, silo rooms (8 to 10 hours)
- Treatment time = f (structural elements, size, rate of temperature rise and ΔT)

Collaborative Research

- **Kansas State University**
  - Basic research (1999) – Dr. Subi (Stored Product pests)
- **CNMA – (2002-06) Canadian National Millers Association**
  - In collaboration with Dr Paul Fields, Winnipeg
- **PERC – Propane Edu. Res. Council**
  - Purdue University (2007-08) – Dr. Maier (bins/silos)
  - University of Minnesota (2008) - Dr. Kells (bed bugs)
- **Oklahoma State University (2007)**
  concrete silos
- **GTI – Gas Technology Institute (2007-08)**
  - Soil Nematodes – MB alternative

Conclusions

- Heat kills all life stages of insects
- Good method to locate insect problems in industrial plants
- Repeat customers = efficacy of heat
- Viable alternative to methyl bromide
- Economies of scale - will make it more affordable
- Effective Bedbug control

TEMP-AIR

- Largest provider of temporary heating & cooling equipment in US
- Custom manufactures HVAC for rental fleet
- 11 regional offices serving northern US

Heat treatments for Stored Products Pest Control since 2000

Construction Heating Equipment

- 6,000+ rental units
  - Up to 4,500,000 Btu/hr
  - Fleet rating 4 BCF/hr
- Natural gas- and propane-fueled heaters
- Steam, hot water, and electric available
- Primary market is commercial/industrial; residential growing

On Site Images

Heater Placement on multiple floors

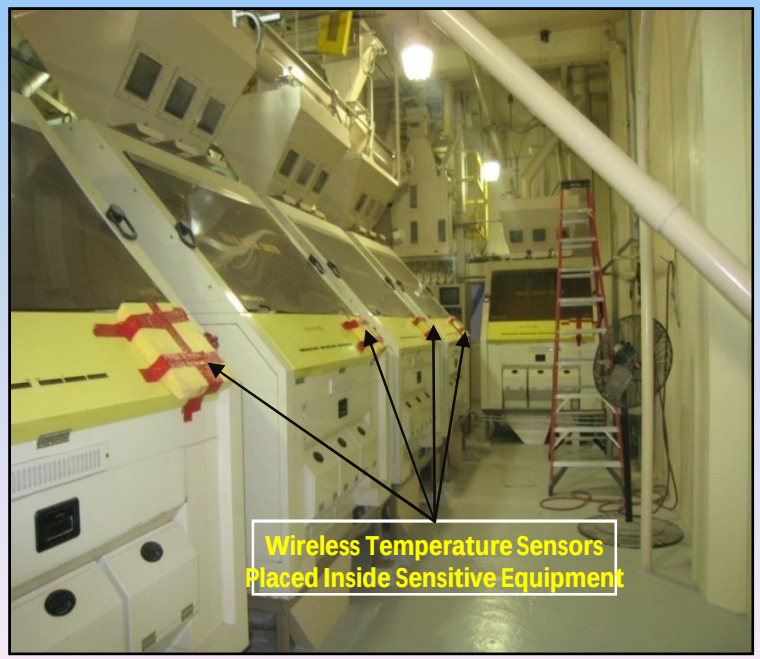
Heater Placement in rolling shutter

Heater Placement & Layout

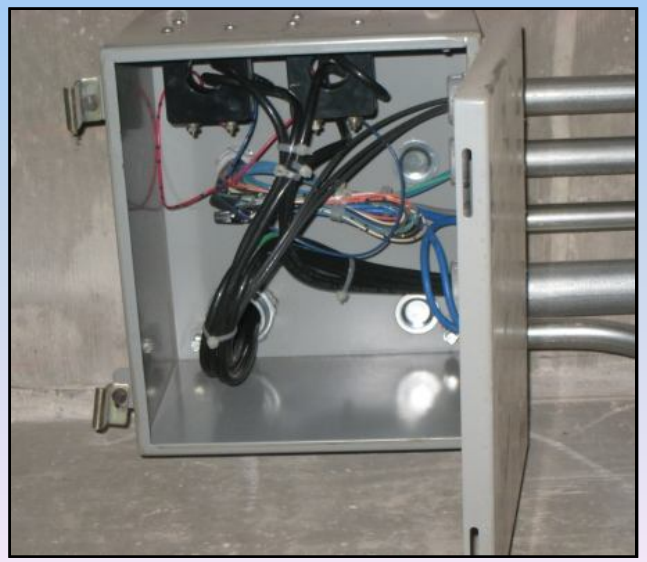
Heater Partially inside Packaging Plant

Duct & Fan Layout - Packaging

Basement, Sensitive Equipment



Detecting hidden infestations



Overhead electrical junction box

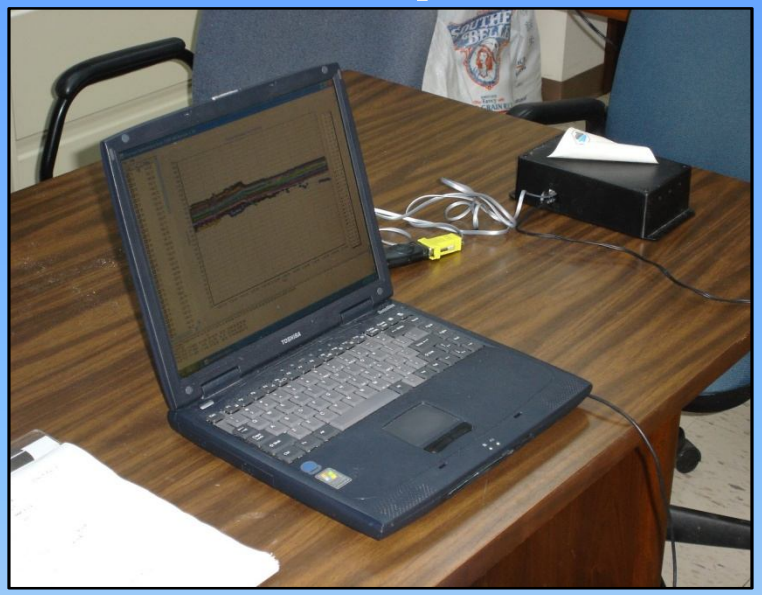
10,000s of adults, larvae, pupae!!

Partial/Spot heat treatment in a warehouse

Partial/Spot heat treatment in a warehouse

Sprinkler heads and opening the machines

Temperature Profile, Beetles, & Rats!!!!



Concrete Bin Basement and Head house

Concrete Bin Basement and Head house

IPM, Pest Control Co., & Heat Treatment

- **IPM - An approach to pest control that includes biological, cultural, genetic, mechanical and chemical means with least environmental damage**
- **Pest Control Cos.: *Uniquely qualified to use multiple strategies***
- **Heat Treatment can be *a tool* in the arsenal of pest control methods and *not necessarily a replacement***

Heat Treatment: Patented scientific process

It’s more of an Art – HOW you apply it

Thank You

THERMAL REMEDIATION
FROM TEMPAIR

Questions?

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