HEAT TRANSFER DISTRIBUTION – CASE STUDIES

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MJN Confidential and Proprietary Information

Heat Transfer Distribution – Case Studies

- **Presentation Outline**
  - Review purposes of Heat Transfer Distribution (HTD)
  - Demonstrate application of IFTPS Guidelines, Chapter 5 on Heat Transfer Distribution
    - Materials and Methods
    - Results
    - Success Criteria Assessment
  - Conclusions & Discussion

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IFTPS Guidelines – Chapter 5 – Conducting Heat Transfer Distribution Studies

- **Objectives of HTD**
  - Identify slower to heat locations, if any
  - Repeatability of slower to heat locations within a retort or study and across retorts and studies
  - Identification of locations for HP studies
  - Verification of the process delivery, for example as part of an overall Change Control program or periodic (e.g., annual) verification effort

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IFTPS Guidelines – Chapter 5 – Conducting Heat Transfer Distribution Studies

- **TD uniformity in a steam/air process may not always correlate to adequate heat transfer**
  - –However, it is a prerequisite for acceptable HTD.

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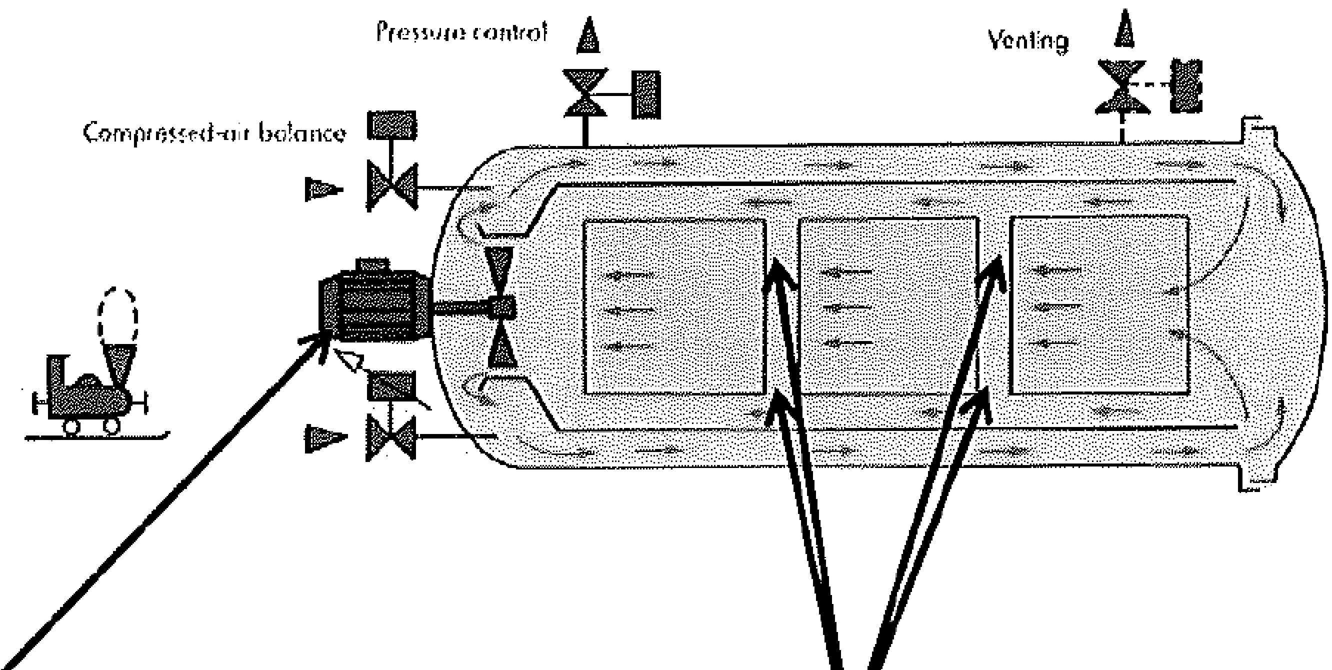

Fan located on the retort door to facilitate mixing and distribution of steam/air.

Steam enters the retort via steam spreaders that are located approximately at 10 & 2 o'clock on top and approximately at 4 & 8 o'clock on the bottom.

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- **Methods**

	Study Parameters	
	Heat Penetration	**Heat Transfer Distribution**
Retort	124.4 C 1.86 bar 5rpm 79.4% Steam, 20.6% Air	125.6 C 1.72 bar 6rpm 86.3% Steam, 13.7% Air
HP/HTD	Product Filled Package Maximum Solids % Maximum Fill Weight DataTrace @ 6second scan interval	Product Filled Package Maximum Solids % Maximum Fill Weight DataTrace @ 6second scan interval
Ballast	Product Filled Bottles	Product Filled Bottles
# Probes	20 pairs of TD and HP located across 5 baskets	20 pairs of TD and HIU located across 5 baskets
# Studies	1	2

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- Datatrace® probes were used for both TD and HP/HTD temperature measurements
  - Programmed to collect data at 6-second intervals
  - A TD probe was located in proximity to each HP/HTD test unit
  - A specific probe location map to identify locations for TD and HP/HTD pairs within the retort load was developed and used
    - Slower and Faster to heat locations were included
    - 20 total pairs in each study located across 5 baskets
- Modeling factors (j_h, f_h, j_c, and f_c) were determined using Numerical® software
- TD data assessed following IFTPS Guidelines, Chapter 4

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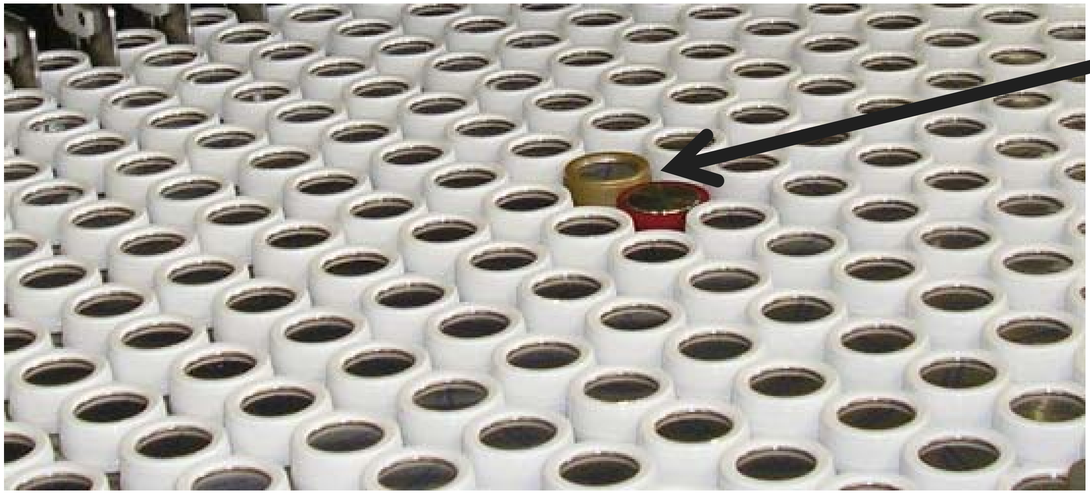

Paired TD probe with probed product-filled bottle

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- **Success Criteria (IFTPS Guidelines, Chapter 5)**
  - Temperature Distribution success criteria have been met for each HTD study.
    - The TID at or above minimum process temperature at end of come-up
    - All TMD's within 0.5 C of minimum process temperature at the end of come-up
    - Once Cook Hold commences, all TMD's at or above the minimum process
    - Uniformity and stability of temperatures confirmed by having no TMD temperature fall below minimum process temperature once that TMD has reached the minimum process temperature
  - Retort control and process conditions achieved/met as designed.

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- **Success Criteria (IFTPS Guidelines, Chapter 5)**
  - f_h %CV ≤5% within and across replicate studies.
  - When this condition has been met, uniform heat transfer conditions have been confirmed and Heat Penetration probes for Process Establishment may be located anywhere in the retort.
  - Verified that the retort is uniform in terms of heat media distribution and delivery and/or the slowest to heat location(s) within the retort load that may be used for HP studies for Process Establishment have been identified.
  - If product-filled packages are used, product functionality and seal integrity are within accepted parameters.

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RESULTS

Average f_h Values						
		A	B	C	D	E
HP	Average					
	STD					
	%CV					
HTD-1	Average					
	STD					
	%CV					
HTD-2	Average					
	STD					
	%CV					
HTD-All	Average					
	STD					
	%CV					

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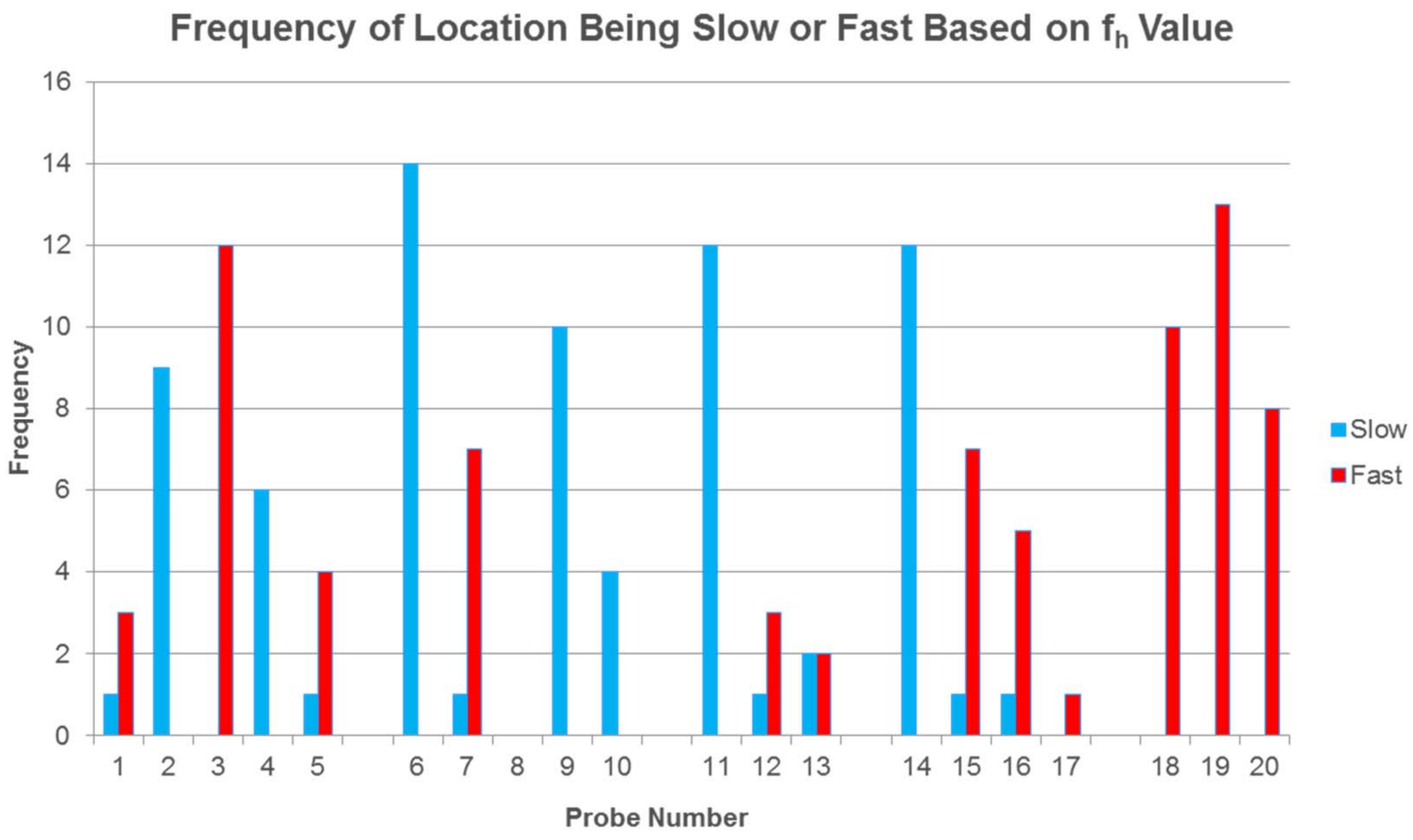

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- Chapter 5 suggests that using HTD data/studies can be used as a means to verify adequate delivery of the thermal process over time

	Comparison of Average f_h Values Over Time	
	2012	**2014**
Product C		
Product D		
Product E		

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- Why not use GM F_0?

Average GM F_0 – Cook End						
		A	B	C	D	E
HP	Average					
	STD					
	%CV					
HD-1	Average					
	STD					
	%CV					
HD-2	Average					
	STD					
	%CV					
HD-All	Average					
	STD					
	%CV					

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- **Why not use GM F_0?**
  - Higher variation when use F_0.
  - Lethal rate is an exponential function so small differences in retort temperature and thus product temperatures have a relatively larger impact on the lethal rate.
  - Using f_h as the assessment criteria eliminates this source of variation and allows one to focus on heat transfer.
    - More appropriate way to assess and evaluate potential limiting heat transfer media distribution over TD or GM F_0

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- **SUCCESS CRITERIA ASSESSMENT**

SUCCESS CRITERIA ASSESSMENT	
CRITERIA	**ASSESSMENT**
Temperature Distribution success criteria achieved	✓
Retort Control & Process Conditions Achieved	✓
f_h %CV ≤5% within and across replicates	✓
Uniformity of heat transfer medium verified	✓
Product functionality and seal integrity within accepted parameters	✓

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Conclusions & Discussion

•Product can effectively be used for HTD studies

•Average f_h values:

- Distinguished between a “minimum, worse case” retort process and the operating process
- Verified the consistency of thermal process delivery over time

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- **SUMMARY**

  – IFTPS Guidelines for Conducting Heat Transfer Distribution Tests provide necessary guidance for collecting and analyzing data from HTD studies.

  – These Guidelines can successfully be applied where a processor has elected to use product instead of other types of materials such as Teflon blocks or bentonite solutions.

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THANK YOU!

QUESTIONS?

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