# Pet Food Safety

June 29, 2011

## Trends Impacting Feed and Food Industry

1) **Food safety**: Challenges with contaminated ingredients and products
2) **Raw material costs**: Volatile ingredient markets
3) **Market conditions**: Current economic recession is impacting consumer buying habits
4) **Energy efficiency and water conservation**: Higher energy costs and concerns about water availability
5) **Emissions control:** Reducing odor and particulate emissions
6) **Supply chain cost reductions**: Shipping costs are higher
7) **Automation**: Reduces labor costs and assists in food safety
8) **Labor costs:** Uncertainties in the labor pool
9) **Flexibility:** Ability to react quickly to new market directions
10) **Lean manufacturing:** Cost cutting and improving efficiencies

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## Possible Food / Feed Safety Concerns

1) Animal by-products
2) Feed additives
3) Banned additives
4) GMO's
5) Veterinarian drugs
6) Botanical impurities
7) Mycotoxins
8) Heavy metals
9) Dioxins
10) Microbes

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## Examples of Most Recent Issues in Food/Feed Safety with International Impact

1) BSE (CWD)
2) Dioxins
3) Melamine
4) Microbial contaminations
5) Mycotoxins

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## > 89% of the Public Supports more Government Regulations
## > 66% Support More Funding for FDA

**Pet Food Manufacturers are reacting to gain confidence of consumers and regulators**:

1) Use the food chain approach to food safety
2) Requires working together in close collaboration among all groups:
   a) Industry/Associations
   b) Government
   c) Academia

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## Four Types of Hazards

1) Physical (foreign objects)
2) Chemical (pesticides, heavy metals, etc.)
3) Biological (bacteria, toxins, etc.)
4) Radiological

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McKinney, L., "Invest in common sense biosecurity precautions", October 2009, Feed International

## 3 Requirements of Food Safety Management System

1) **Management system** based on the process approach and customer focus
2) **GMP (Good Manufacturing Practices)**: programs to assist in controlling the likelihood of introducing hazards to feed products through the work environment
3) **HACCP (Hazard Analysis and Critical Control Points)**: a program to identify all relevant hazards (some to be managed through GMP and some through the CCP's)

(GMP = BPF HACCP=APPCC)

## Implement Food Safety Plans and Programs !

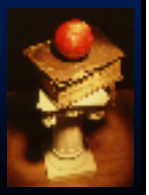
Raw material →  → Final product

Systematic, scientific approach to food safety!

## Establish the Right Culture:

1) Training: **How** to perform the required tasks
2) Education: **Why** tasks are important





## GFSI
## Global Food Safety Initiative

Retailer-driven group with objective to establish commonly-accepted food safety standards through guidance documents that benchmark schemes seeking compliance. Standards accepted include:

1) BRC (British Retail Consortium)
2) ISO 22000
3) SQF (Safe Quality Foods) 2000, level 2*
4) FSSC 2000
5) International Food Standard
6) GAA

*SQF appears most appropriate for Pet Food Production

## Where Do We Start? (3 requirements of Food Safety Management System)

1) **Management system** based on the process approach and customer focus
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3) **HACCP**: a program to identify all relevant hazards (some to be managed through GMP and some through the CCP's)

## Responsibility of Management:
## A) RESOURCES

1) Education/awareness of personnel
2) Personal hygiene/work environment
3) Required facilities/equipment provided
4) Control of monitoring /measuring devices
5) Maintenance programs
6) Cleaning/sanitation/pest control
7) Waste control

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## Responsibility of Management:
## B) OPERATIONAL

1) Handling of incoming materials
2) Prevention of cross-contamination
3) Rework
4) Production
5) Labeling of finished feed products
6) Storage
7) Transport

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## Responsibility of Management:
## C) SYSTEM COMPONENTS

1) Documentation
2) Traceability
3) Inspection, sampling, analysis
4) Control of non-conforming product
5) Crisis management (recalls, etc.)
6) Internal audits/third party audits

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## GMP's
## (The actual practices or procedures)

1) Construction/layout of building
2) Equipment (cleaning/maintenance)
3) Management of incoming raw materials (storage)
4) Cleaning/sanitation/pest control/personal hygiene
5) Prevention of contamination
6) Rework/waste management
7) Product withdrawal and recall

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## HACCP
(Hazard Analysis and Critical Control Point)

1) Conduct a hazard analysis
2) Determine Critical Control Points (CCP)
3) Establish critical limits
4) Monitor the control of CCP's
5) Corrective actions if controls fail
6) Verify HACCP is working
7) Document all procedures (records)

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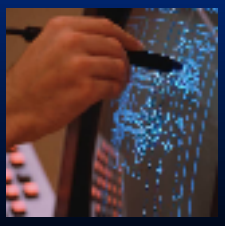
## Critical Control Point (CCP)

"If a hazard needs a specific control, and there is no point further downstream in the process to reduce or eliminate it, it is a CCP."



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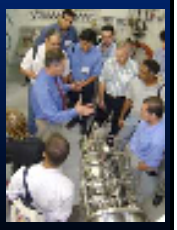
## Critical Areas of Impact - Elements of Food Safety Program

1) Incoming raw materials
2) Processing/Manufacturing
3) Record Keeping
4) Distribution/Transportation/Feeding
5) Inspection/Audit/Corrective Action
6) Responsibilities
7) Training



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## Food Safety System: Incoming Raw Materials

1) Assure identity of materials (COA especially on ingredients and pkg. materials not subject to "kill step")
2) Test for contamination
3) Receiving procedures
4) Storage
5) Inventory control
6) Written SOP's

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## Use of Food Grade Anti-Microbials in Pet Foods

1) Acidulants and blends of organic acids
2) Acidic calcium sulfate (ACS) tested at 2.4% internally and in coating
3) ACS had no *Salmonella* detection after 13 days storage with $10^4$ cfu/g inoculation after extrusion
4) Impact on palatability?

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## Processing/Manufacturing

1) Building and equipment design
2) Building and equipment maintenance
3) Critical Control Points in the process
4) Written SOP's

Building and equipment must enhance sanitation and prevent cross-contamination!

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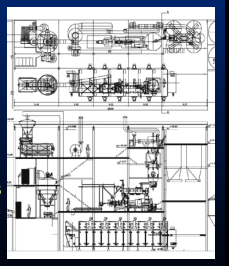
## Building and Equipment Design

1) Plant layout –vertical versus horizontal flow
2) Multiple rooms / isolation walls
3) Airflow control
4) Equipment/personnel traffic management
5) Segregate “wet” and “dry” areas
6) Plant location
7) Transitions



## Building and Equipment Design (continued)

8) Minimize product and dust leakage, spillage, and accumulation
9) Easy access for inspection and cleaning
10) CIP versus COP
11) Capture/recycle under-processed material

## Processing: Five common critical control points

1) Proper mixing time in batch mixer
2) COA and raw material analysis (includes packaging material)
3) Establish minimum extrusion temperature
4) Establish maximum final product moisture
5) Metal detection/X-ray profiling for foreign objects in final product package

## Critical Control Point

## Preconditioned Feed Inoculated with $10^4$ CFU *Salmonella Typhimurium* / gram

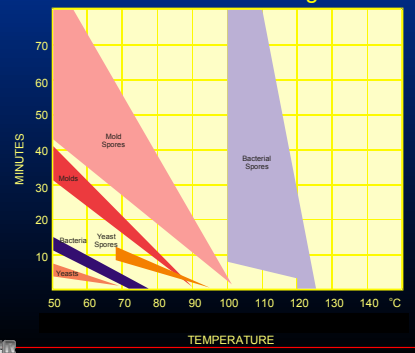
| Sample | Process moisture (%) | Product temperature (ºC) | Retention time (minutes) | Salmonella presence |
|---|---|---|---|---|
| 1 | 17.4 | 82.8 | 3.58 | Negative |
| 2 | 16.5 | 83.3 | 3.05 | Negative |
| 3 | 22.2 | 82.2 | 2.70 | Negative |
| 4 | 18.8 | 70.0 | 2.20 | Negative |
| 5 | 15.9 | 70.0 | 1.92 | Negative |

Hoffmans, C.M. and Fung, D.Y.C., “Effective Method for Dry Inoculation of Bacterial Culture”, Journal of Rapid Methods and Automation in Microbiology, I (1993) 287-294.

## Continued studies to validate effectiveness of preconditioner at higher contamination levels

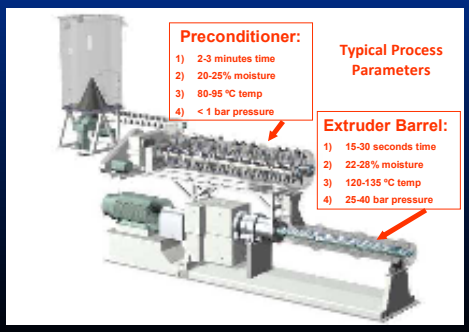
2008 studies indicate that a preconditioner is effective even against $10^6$ CFU when operated at ≥ 22% moisture levels and temperatures > 77°C

## TEMPERATURES REQUIRED TO KILL Various Classes of Microorganisms




Source: 2008, January, Dr. Daniel Fung, "Synopsis of Food Microbiology" Seminar

## Preconditioner and Extrusion Process

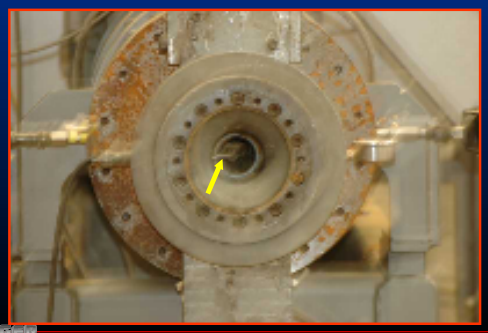



## Extrusion of Pasteurized Products

## Must Validate Effectiveness of Critical Control Point (Extrusion as Kill Step for Salmonella)

1) **R & D Scale**: inoculate feed and confirm minimum temperature (CCP)
2) **Production**:
   a) Test presence in raw materials
   b) Record process parameters (product temperature)
   c) Test final product
3) **Peer-reviewed Scientific publications**
4) **Processes as described above but using appropriate surrogate**

## Critical Control Point – Product Temperature at Discharge of Extruder



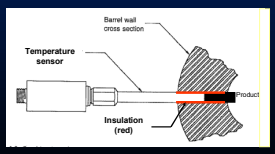
## Impact of Thermocouple Location on Product Temperature Readings

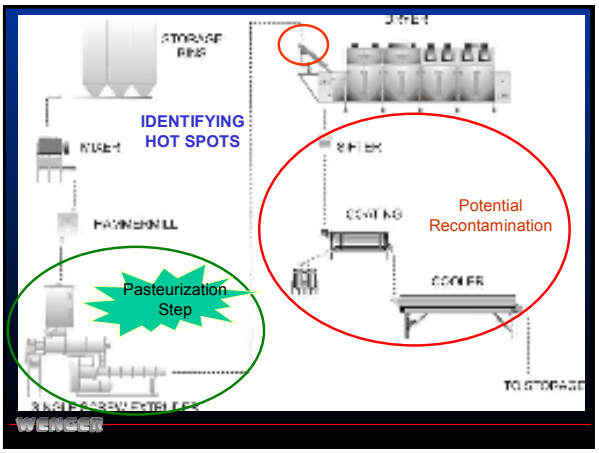
| % Retracted* | Product temp (C) |
|---|---|
| 0 | 140 |
| 33.3 | 139 |
| 50 | 138 |
| 66.7 | 135 |
| 83.3 | 122 |
| 100 | 104 |

* 0% retracted = center of product flow; 100% retracted = flush with sidewall

## Product Temperature Sensor

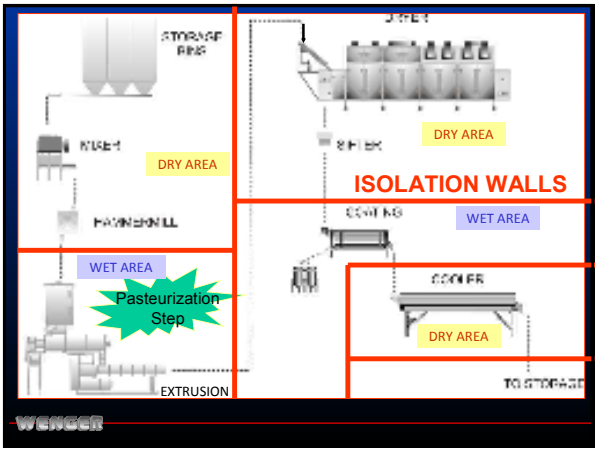
1) Extend temperature sensor at least 6mm into product stream – preferably 25 mm
2) Add metal sheath to protect tip from wear
3) Insulate where sensor passes through equipment wall
4) Use duplicate sensors
5) Calibrate sensors
6) Locate behind die
7) Traceability records




## Plant and Equipment Design

1) Isolation Walls
2) Product transfer
3) Airflow control and treatment
4) Equipment design and construction
5) Closed loop systems
6) Control systems and on-line devices

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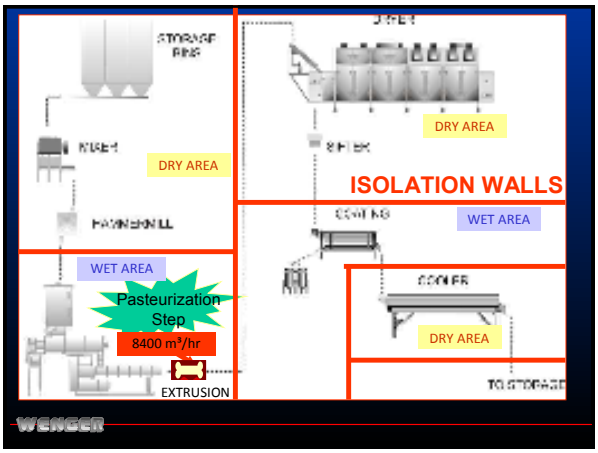
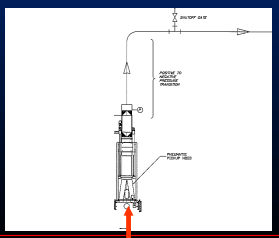
## Conveying Devices

1) Eliminate where possible
2) Sanitary design for minimal material buildup and ease of cleaning
3) Closed loop
4) Heated air intakes and heated transfer points




## Typical Pneumatic Conveying Systems for Pet Food Products



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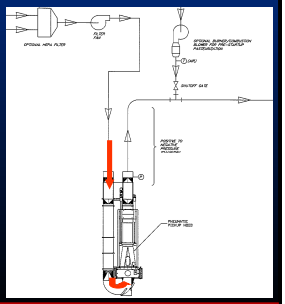
## Hygienic Pneumatic Conveying Systems

1) HEPA filter air intake
2) Burn-out sanitizing mode
3) Strategically located temperature sensors
4) Positive pressure at die/knife area
5) Positive pressure at sampling port



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## Plant and Equipment Designs

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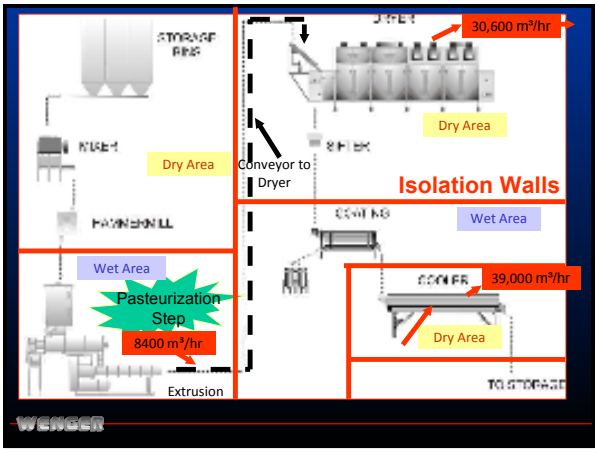


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## Fugitive Dust From Processing Equipment

Salmonella is a survivor – 300 days in dust!

## Preconditioner Slide Gate and Dust-Tight Downspout

1) Designed to reduce waste (under-processed product)
2) Easy access for inspection and cleaning
3) Designed to minimize leakage/spillage and exhaust streams


## New SS Hygienic Equipment Frames

## Dryers and Coolers

1) Emissions (fugitive dust)
2) Ease of cleaning/inspection
3) Minimize product accumulation
4) Product temperature
5) Cross contamination
6) Maintenance
7) Written SOP's

## Plant and Equipment Designs

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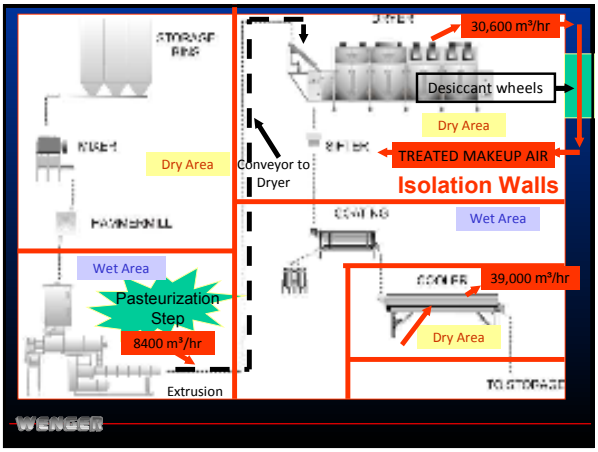

## Plant and Equipment Designs

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## Capturing and Containing Under-Processed Material to Prevent Re-Contamination

1) Preconditioner and Extruder Venting
2) Waste Recycling Systems (WRS)
3) Bypass valves (BPV) to prevent under-processed material going to die assembly

## Closed loop systems for capturing, containing, and recycling fugitive or under-processed material

Reclamation systems to recover wet, under-processed product and fugitive dust streams

## Typical preconditioner venting with escaping excess steam and recipe particulates

Before

After installation of "capture system"

## Plant and Equipment Designs

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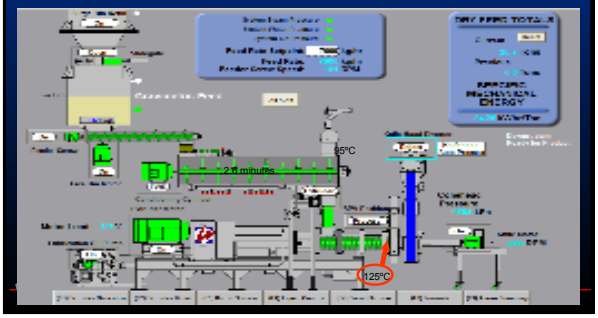
## Critical Control Point Displayed and Recorded

Extruder Temperature



## On-line devices to decouple personnel from direct product contact

1) On-line measurement of product technical qualities
2) Remote digital imaging

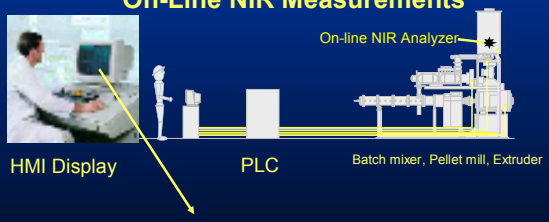
## On-line Product Measurements

1) Bulk density
2) Moisture
3) Temperature
4) Photographic recognition
5) Proximate analysis
6) Presence of contaminants


Is the 3 year payback rule valid for quality assurance expenditures?

* from Source Technologies

## Example Safe-Guards: On-Line NIR Measurements*




| | |
|---|---|
| 32.2% Protein | 7.8% Fat |
| 4.2% Fiber | 5.6% Ash |
| 9.8% Moisture | 11.8% Starch |
| Warning! Melamine Possibly Present | |

*From Perten

## Treatment of Grains Contaminated with Mycotoxins

**(Fungal toxins - origin field or storage)**

1) Good agricultural practices would minimize risks
2) Testing and COA's of incoming raw materials
3) Physical, chemical, or biological treatments of contaminated pet food have poor efficacies and are not economically viable
4) Organic and inorganic absorbents decrease effects but not allowed in EU

## The Way Forward – Pet Food Safety

1) Implement Food Safety Management Systems (SOP's, GMP's, HACCP)
2) Supplier quality assurance program (COA's especially for pkg. material and ingredients not subjected to elevated temperatures)
3) Establish and validate "Critical Control Points" in process
4) Plant and equipment design (to reduce and control recontamination)

## Benefits of Pet Food Safety Program

1) Reduces risks
2) Decreases wastes, shrink, and customer complaints
3) Tracks and traces products
4) Lowers product liability insurance
5) Protects hard-won brand value

Source: AFIA's Food Safety Certification Program; I-SF/SF