Shipping temperature-sensitive seafood

1 November 2008 Thomas E. Rippen Lisa Weddig

HACCP monitoring challenge

A typical temperature-recording device used in shipping containers. Photo courtesy of Sensitech Corp.

Like many other foods, seafoods are increasingly sourced and shipped globally to numerous markets in both traditional importing countries like the United States, Europe and Japan, and countries experiencing rapid growth, like China and even Russia. Virtually all receiving countries and commercial customers now require hazard analysis critical control point (HACCP) controls for assuring the safety of the products they buy.

Time-, temperature-sensitive products

Seafoods requiring time/temperature controls in transit include refrigerated vacuum-packaged fresh or smoked fish, histamine-forming species such as mahi-mahi and tuna, and those receiving a moderate terminal heating step, like pasteurized crabmeat. Pasteurized crab products are of primary concern since few other refrigerated (not shelf-stable, unfrozen) seafoods have the required shelf life for international shipment.

Although these products receive a thermal process adequate for the destruction of most spoilage and disease-causing bacteria, they must be held under refrigeration to prevent the growth of the limited number of pathogens capable of surviving the pasteurization process, notably proteolytic strains of *Clostridium botulinum* bacteria, the organism responsible for botulism, and Bacillus cereus bacteria. The industry is very aware of the importance of tight temperature controls to maintain high quality as well as food safety assurance, and the safety record for these products is excellent.

HACCP plans for pasteurized crabmeat imported into the U.S. commonly include a temperature limit of 4.4 degrees-C during shipping and subsequent storage before distribution. The time allowed above this temperature is typically four hours. This restriction may be unnecessarily conservative for food safety and appears to have originated from a misinterpretation of the U.S. Food and Drug Administration (FDA) Fish and Fisheries Products Hazards and Controls Guidance documents.

Practical controls

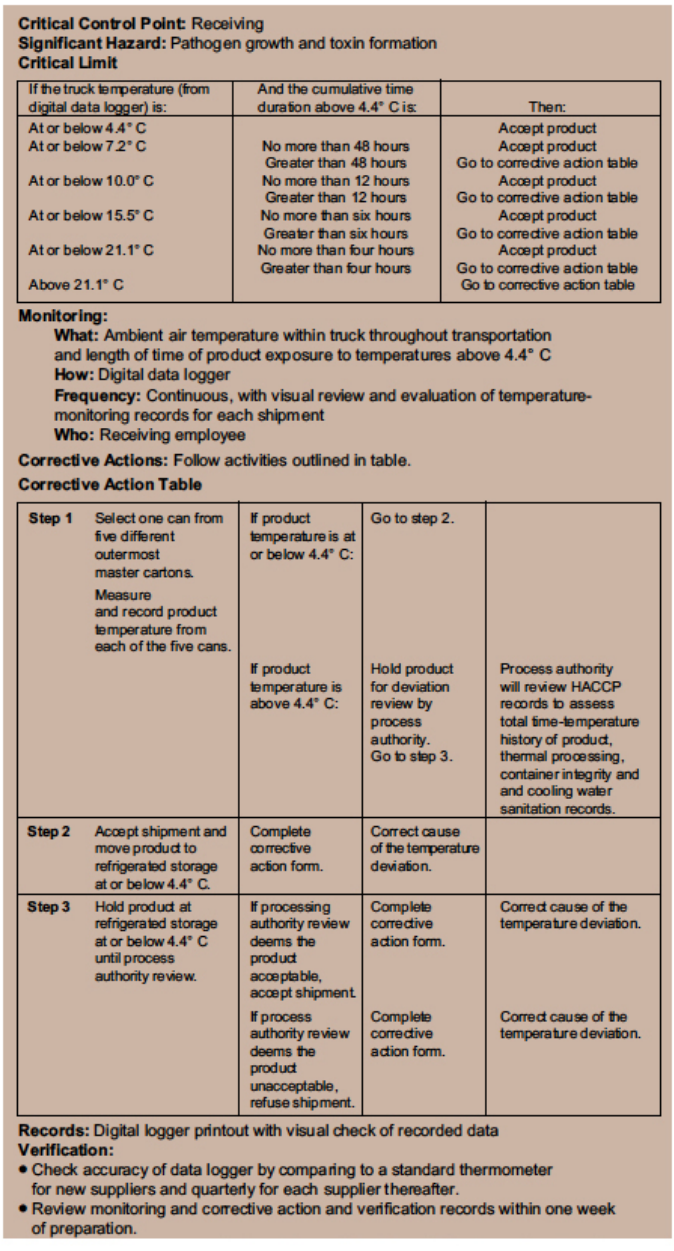
An RFID tag used to track products and temperatures in transit. Photo courtesy of Intrafab, Inc.

U.S. importers and distributors are working with FDA and the National Seafood HACCP Alliance to find more practical recommendations for shipping and storage of pasteurized crabmeat.

The National Fisheries Institute wrote the FDA with concerns, noting that its guide recommends a maximum cooler temperature of 4.4 degrees-C for a critical limit to control the growth of pathogens. FDA also recognizes that when refrigerated fishery products are transported from processor to processor only a short distance (four hours or less travel time), continuous monitoring of temperature would not be required.

“We believe that these two separate expectations have been combined into a de facto critical limit which results in product being automatically rejected if the refrigeration temperature exceeds 40 degrees-F (4.4 degrees-C) for more than four hours,” NFI wrote.

There are various approaches for building less-restrictive critical limits and corrective actions into a HACCP plan, all based on the use of a continuous record of shipping/storage temperatures for evaluating critical limits. One example that could be incorporated into a HACCP plan is presented in Fig. 1. Contact the main author for important details before implementing this strategy.



Critical Control Point: Receiving
Significant Hazard: Pathogen growth and toxin formation
Critical Limit

If the truck temperature (from digital data logger) is:	And the cumulative time duration above 4.4° C is:	Then:
At or below 4.4° C		Accept product
At or below 7.2° C	No more than 48 hours	Accept product
	Greater than 48 hours	Go to corrective action table
At or below 10.0° C	No more than 12 hours	Accept product
	Greater than 12 hours	Go to corrective action table
At or below 15.5° C	No more than six hours	Accept product
	Greater than six hours	Go to corrective action table
At or below 21.1° C	No more than four hours	Accept product
	Greater than four hours	Go to corrective action table
Above 21.1° C		Go to corrective action table

Monitoring:
What: Ambient air temperature within truck throughout transportation and length of time of product exposure to temperatures above 4.4° C
How: Digital data logger
Frequency: Continuous, with visual review and evaluation of temperature-monitoring records for each shipment
Who: Receiving employee

Corrective Actions: Follow activities outlined in table.

Corrective Action Table

Step 1	Select one can from five different outermost master cartons. Measure and record product temperature from each of the five cans.	If product temperature is at or below 4.4° C:	Go to step 2.	
		If product temperature is above 4.4° C:	Hold product for deviation review by process authority. Go to step 3.	Process authority will review HACCP records to assess total time-temperature history of product, thermal processing, container integrity and and cooling water sanitation records.
Step 2	Accept shipment and move product to refrigerated storage at or below 4.4° C.	Complete corrective action form.	Correct cause of the temperature deviation.	
Step 3	Hold product at refrigerated storage at or below 4.4° C until process authority review.	If processing authority review deems the product acceptable, accept shipment.	Complete corrective action form.	Correct cause of the temperature deviation.
		If process authority review deems the product unacceptable, refuse shipment.	Complete corrective action form.	Correct cause of the temperature deviation.

Records: Digital logger printout with visual check of recorded data
Verification:
- Check accuracy of data logger by comparing to a standard thermometer for new suppliers and quarterly for each supplier thereafter.
- Review monitoring and corrective action and verification records within one week of preparation.

Fig. 1: Sample receiving critical control point for refrigerated pasteurized crabmeat based on the use of a continuous record of shipping/storage temperatures for evaluating critical limits.

Monitoring

With the international expansion in the use of HACCP, a wide variety of temperature-monitoring and recording devices have come to market in recent years. Most are small digital loggers that can be activated when a shipping container is filled and then downloaded by computer and read at receipt. Other types of recorders are also available, from mechanical paper chart recorders to sophisticated radio-frequency identification (RFID) devices.

A complicating factor is that shipping containers are frequently delivered to public cold storage facilities, where they may be divided into 50 or more orders and delivered by various trucking companies, usually common carriers. The original temperature recorders are often returned to the U.S. importers and, although recorders are normally installed on trucks, no continuous temperature record is available from foreign production plant to final customer.

HACCP plans, including those that allow for multiple time and temperature combinations, work best when the complete time/temperature history is known in detail, especially when determining appropriate corrective actions. This is because time/temperature abuse is additive. Relatively minor temperature spikes at several locations in the distribution chain could potentially breach overall critical limits even if each event is independently passable.

RFIDs

Recent advances in RFID technology may finally solve this problem. These devices emit a radio frequency containing product code, date/time, location, temperature and other information that can be read by scanners. About the size of a credit card, they can accompany products along their entire route as long as the tagged products are scanned.

The problem of multiple small deliveries can be addressed by transferring the information from the original foreign shipment tags to a set of tags that accompany each small subshipment. This process can be repeated if customers want to use the tags to monitor their own deliveries.

Anyone with authorized access can view the history of the products via the Internet. Confidentiality concerns between buyer and seller can be addressed by limiting the amount of information available to specified users. For example, the entire time-temperature history might be available to the foreign packer and U.S. importer, while only the history since release from U.S. cold storage might be viewable by each customer for the products they ordered.

To simplify things further, customers might simply view light-emitting diode lamps on the card at receipt indicating “pass” or “fail” for identified parameters. Many combinations are possible. The histories of numerous loads can be viewed from computers or handheld devices and easily organized electronically. The cost of RFID scanners is coming down, making what until recently was an intriguing but impractical technology an economically feasible option for seafood importers and distributors.

(Editor’s Note: This article was originally published in the November/December 2008 print edition of the Global Aquaculture Advocate*.)*

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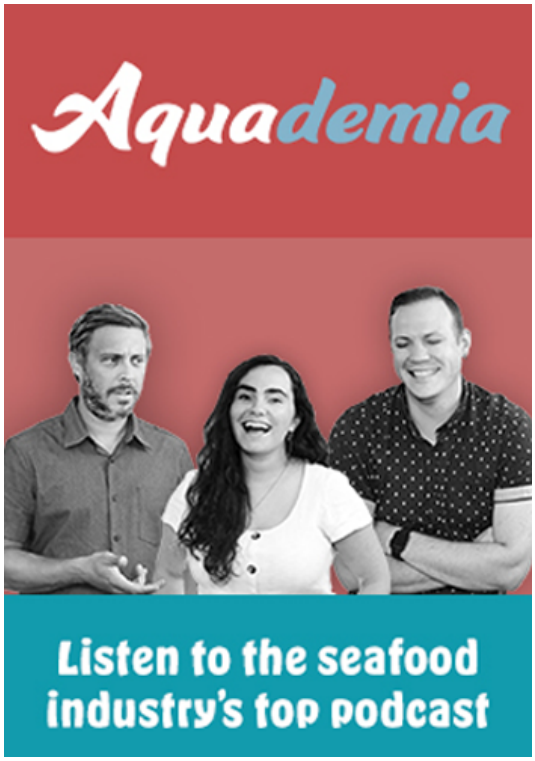

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