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Pollution Prevention Opportunities  
in the Fish Processing Industry

**Pacific Northwest  
Pollution Prevention Research Center**

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*Funded by a grant from the Pollution Prevention Office  
of the Alaska Department of Environmental Conservation*

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## **Pacific Northwest Pollution Prevention Research Center, 1993**

The Pacific Northwest Pollution Prevention Research Center (PPRC) is a public non-profit foundation serving Alaska, Idaho, Oregon, Washington, and British Columbia. The PPRC sponsors research on pollution prevention, analyzes available technology, hosts forums, acts as an information clearing-house, and serves as a link between public and private groups.

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# **Pollution Prevention Opportunities in the Fish Processing Industry**

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*A Northwest Industry Roundtable Report*

## **Introduction**

As part of its efforts to reduce pollution in the Northwest, the Pacific Northwest Pollution Prevention Research Center (PPRC) has organized a series of roundtables to explore pollution prevention opportunities in key Northwest industries, including fish processing. The purpose of the roundtables is to encourage discussion of pollution prevention among industry representatives, identify opportunities as well as barriers to implementation, and target areas for future research. Funding for the roundtable was provided by a grant from the Pollution Prevention Office of the Alaska Department of Environmental Conservation, which has been directed by state legislature to identify research needs for state business and industry.

The fish processing roundtable, held in Seattle on September 30, 1992, brought together 21 individuals active in the processing and marketing of Pacific Coast finfish and shellfish. Facilitated by the Northwest Renewable Resources Center, the discussion focused primarily on Alaskan fisheries and included technological improvements affecting waste reduction, economic impediments, communication needs, recycling efforts, and markets for waste products.

This report offers information on waste streams from fish processing and harvesting, conclusions reached during the roundtable discussions, and recommended topics for future research. Appended to the report are a list of participants, a bibliography of selected readings, and a resource listing of other key individuals and organizations involved with this industry.

## **Fish processing and harvesting waste streams**

The fish processing industry currently converts 20-25 percent of usable meat from an average pollock catch. An estimated 1.7 million metric tons of fish waste are generated per year in Alaska alone, with over 100,000 tons of waste coming from the Bering Sea crab fisheries. These large volumes of wastes reduce the levels of dissolved oxygen in the water and generate toxic by-products during decomposition, contaminating aquatic habitats and threatening a variety of resources.

Waste disposal. Wastes generated during at-sea processing, consisting largely of fish parts, are currently ground to EPA specifications (half-inch pieces) and then discharged overboard. On-shore processing facilities are regulated under state and federal water permits, and are subject to air quality and solid waste management restrictions. Disposing of wastes on shore puts pressure on landfills, especially in rural Alaskan communities. The ability to discharge at sea is currently viewed by some as giving off-shore

processors a competitive advantage over their on-shore counterparts, who are subject to more restrictive, and consequently more expensive, environmental control measures.

**Industry constraints.** In many ways, the fish processing and harvesting industries are unique in their waste streams and in the specific constraints of their operations, including the often remote locations involved. One key factor is the seasonal nature of fishing operations. Surge periods in processing (open seasons) require full capacity operation for short periods with little opportunity for down time. The economics of the present system for fishery management, promoting race-to-the-finish fishing, offer little incentive for waste reduction. At-sea processors are also limited by space constraints, in addition to time pressure. Comprehensive waste reduction programs are difficult to implement, and to enforce, under these conditions, and little regulatory pressure is currently being exerted.

#### **Waste reduction opportunities**

Although there has been progress in managing wastes from the fish processing industry, the huge volume of waste currently generated has led both industry and government agencies to explore further reduction and use enhancement opportunities. A memorandum of understanding between EPA and the state of Alaska examines pollution issues in Akutan and Unalaska, and Total Maximum Daily Load (TMDL) analyses are being jointly conducted by industry and government.

**Increased processing efficiency.** One area of significant potential waste reduction in the fish harvesting and processing industries is increased processing efficiency, which reduces waste and increases productivity by extracting more meat per fish. A technique that increases efficiency by as little as 1/2 of one percent is sufficient to generate widespread industry interest, and both the National Food Processors Association and the National Marine Fisheries Service have been active in promoting research in this area. For example, a fish head splitter has been developed that removes meat from the cheeks, neck, other areas previously considered too difficult to access. Other methods that enhance waste reduction during processing include mechanically recovering usable meat from frames in the mince process, using centrifuges to recover fish from the process rinse water, and recovering crab meat through brine flotation systems in processing plants.

**Reduction of by-catch.** During fish harvesting, the primary focus of waste reduction efforts is by-catch (capture of non-target fish species with the catch, which are subsequently thrown overboard). The Alaska Fisheries Development Foundation is attempting to fund a study examining the configuration of net cod-ends in an effort to reduce the catch of undersized fish. Trawl net manufacturers are experimenting with new designs that would reduce or eliminate the catch of undersized specimens or unwanted species. Controlling for product size is becoming increasingly important: Some Alaskan pollock fisheries were closed for six weeks in 1992 because stocks were not large enough to process economically.

**Marketable by-products.** Another waste reduction target for the industry is the transformation of fish wastes into marketable by-products. Surimi and flaked fish for institutional sale are recent examples of products created from previously undervalued fish parts. Chitin and chitosan, chemicals extracted from crab and shrimp shells, produce chitinous polymers similar to cellulose. Chitosan can be used in the treatment of municipal wastes, the manufacture of animal meal products, and various medical applications.

**Uses for fish residuals.** Potential uses for fish residuals, or offal, are being examined closely by several organizations in Alaska. Hydrolyzed wastes can be used for fish or pig meal, as well as fertilizer

components. Fish oils are being successfully used as a fuel additive in boilers in a Dutch Harbor processing plant, Some firms have sold carapaces for food presentation in restaurants. In addition, a number of companies are currently examining uses for stickwater, the wastewater stream from fish meal production.

**Other opportunities.** Waste minimization audits of plant operations have been valuable in identifying waste reduction opportunities. Reduction of packaging waste, fuel oils, cleaning chemicals, and other maintenance and operations wastes can significantly reduce material and shipping costs to remote plant locations. A roundtable participant from an Alaskan salmon enhancement facility noted that his facility is researching such options as combining their waste with that of a Juneau brewery to create marketable product. Heat produced by a Juneau incinerator would be used to convert approximately 1000 tons of fish waste produced annually into salmon feed (currently a \$400,000 per year expense item).

### **Roundtable conclusions**

There was a general sense among the roundtable participants that the technology to deal with many of the industry's waste issues already exists. However, the remote locations of the processing facilities and fisheries, the timing of fishing seasons, the high transportation costs, the lack of markets for waste products, and other factors often act as barriers to implementation of that technology.

**Practical considerations.** Industry representatives agreed that grinding and discharging wastes is not a satisfactory long-term solution, but alternatives are frequently impractical. For example, space constraints on crowded floating processors may prohibit the installation of equipment to produce fish meal from waste, even though the technology is readily available. Bering Sea crab waste was another frustrating subject for the roundtable participants. Processing this waste requires significant quantities of financial capital and flat land, both of which are in short supply in the Aleutian Islands.

**Developing new markets.** The need to develop markets for new products was expressed again and again throughout the roundtable. Much of the current marketing effort has focused on expanding sales to existing buyers, rather than seeking out new markets. Chitin and chitosan, the materials extracted from shrimp and crab shells, were cited along with fish meal as examples of products that have been available for years but suffer from inadequate market development. More aggressive marketing was seen as essential to providing the industry with incentive to create new products.

**Reducing by-catch.** Another frequently mentioned topic was the reduction of by-catch during harvesting. Participants expressed interest in a variety of studies currently being conducted into improvements in net design. For instance, a program is currently being monitored by the National Marine Fisheries Service in which unwanted by-catch is returned to the water alive, and therefore not counted against by-catch quotas. It was also suggested that other uses for by-catch, such as donating it to food banks, be investigated.

**Improving plant operations.** None of the attendees foresaw any improvements in plant operations or maintenance that could significantly reduce waste. Cleaning is performed frequently and almost entirely with water, which is in abundance in this region. Operation and maintenance procedures, driven by sanitation concerns, are given high priority.

**Solidwaste recycling.** Industry representatives felt they had made a great deal of progress in solid waste reduction over the past few years. Much of the industry is now recycling oil, wrapping paper, batteries,

and other materials in order to reduce the pressure on rural Alaskan landfills. Alaskan representatives noted, however, that there is often difficulty recycling materials in Alaska due to high transportation costs and lack of in-state markets for recycled materials.

**Industry shakeout.** Several participants voiced the opinion that the entire fishing industry is in the midst of a decade-long ownership and management shakeout which will inevitably produce changes. Because of the narrow profit margins in the industry, the representatives felt that changes must be adopted everywhere simultaneously, to avoid giving one operator an unfair advantage. They all agreed that the industry is strongly interested in gathering new information on both waste reduction and recycling.

### **Research recommendations**

On the subject of research, the industry representatives indicated a reluctance to contract for research through universities because of the common university policy of retaining all patent rights to the results. Research, they felt, must be a partnership between industry and academia. It was suggested that Pacific Fisheries Technologists, a broad-based group representing industry, academia, and regulators, might serve as a catalyst for promoting or conducting appropriate research.

**Joint programs.** Another suggestion was to develop a joint program between government and industry to pool resources and fund needed research, modeled after a coalition group that serves the oil industry by sharing research information. Although many of the participants felt this was a worthy goal, several felt that competition within the fishing industry would make such collaboration difficult.

**Economic implications.** Virtually all the participants stressed that meaningful research must include economic implications, practical applications, and market potential. This point was strongly emphasized by one participant, who noted that implementation of research can be delayed by years if market issues are not considered from the outset. Demonstration projects were seen as especially valuable.

**Suggested research topics.** The following topics were mentioned during the roundtable as suitable for further research:

- Improving communication on waste issues. Communities, companies, regulators, equipment manufacturers, and consumers all need to be part of this process.
- Creating a support infrastructure for the fishing community similar to the role of the Agricultural Extension Service.
- Exploring the opportunities and challenges involved in backhauling fish waste out of Alaska for processing in other states until Alaskan waste processing capability increases. Although the volume of waste is enormous, its value is considered so low that the ability to conduct large-scale shipments economically is highly questionable.
- Conducting market research to identify new products for fish wastes, and new markets for existing fish products.

- ❑ **Compiling a listing of best management practices (BMPs) for the fish processing industry.**
- ❑ **Investigating the possibility of selling hydrolyzed shellfish carapaces for silage, as New Brunswick currently does for the European market.**
- ❑ **Developing uses for the crab waste generated in Western Alaska (Dutch Harbor, Akutan, St. Paul Island, and Kodiak).**
- ❑ **Researching the feasibility of extracting crab flavor from shells for use in surimi and then selling the shells to a company for the manufacture of chitosan.**
- ❑ **Exploring uses for the dried concentrate by-product recovered from meal plants.**

***Future meetings.*** Roundtable participants agreed that the meeting had been very useful and should become an annual event, probably taking place in Alaska. The inclusion of representatives of various sides of pollution prevention issues, such as industry and regulators and producers and users of waste materials, was seen as particularly valuable. Several attendees remarked on the importance of holding such a forum at a time when the industry was not being confronted with a crisis situation. The industry representatives voiced a strong desire to put time and effort into proactive, rather than reactive, pollution prevention planning.

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## Appendix B Bibliography

### Fish Processing

“AFDF helps KRI target profits from seafood by-products,” *No Guts, No Glory*, Alaska Fisheries Development Foundation, April 1989.

“Facing the Challenge of the 21st Century Consumer,” George Pigott, 1992.

“Initial Survey of the Seafood Processing Industry in Alaska, Washington, and Oregon,” U.S. Environmental Protection Agency Region X, Technical Report TC 5316-50, September 4, 1992.

“Processing Plant Waste Management Guidelines,” Roy Carawan, North Carolina Pollution Prevention Program, 1991.

“Reduction in Waste Load from a Seafood Processing Plant,” Beaufort Fisheries, NC State University, 1986.

Seafood and the Environment Symposium, 1991 Seafood Environmental Summit, Raleigh, N.C.

“South Bay Pilot Project: Pollution Prevention Efforts in the South San Francisco Bay Area,” Ben Machol and Claire Elliot, US EPA Region 9.

“Waste Audit of a Bottom Fish Processing Plant,” Southwest Alaska Municipal Conference Fish Processor Project, March 1992.

“Ways to Reduce, Reuse, and Recycle Solid Waste Generated by Southwest Alaska’s Fish Processing Industry,” Southwest Alaska Municipal Conference, September 1992.

### Chitin and Chitosan

“Chitin and Chitosan, Versatile Polysaccharides from Marine Animals,” Nawal K. Mathur and Chander K. Narang, *Journal of Chemical Education*, November 1990.

“Life After Death For Empty Shells,” Stephen Nicol, *New Scientist*, Feb 9, 1991

“Recovery and Utilization of Chitin and Chitosan in Food Processing Waste Management,” Dietrich Knorr, *Food Technology*, January 1991.

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