carton with ice water, allowing a complete glaze to form around each individual shrimp, then draining and packing the cartons into masters.

Shrimp should never be glazed nor packed into masters until the center of each package has reached zero degrees fahrenheit. Glazing should only be done with ice water. These points cannot be too greatly emphasized.

The plants on the West Coast of Mexico, which in the main use the pan-freezing system, drop the pans into ice water for removal of the block of shrimp and frozen water, and place the entire block in a cardboard carton for shipment. Breaking out the shrimp in ice water effectively coats any exposed shrimp with a glaze.

One of the main sources of damage to frozen shrimp which occurs during *storage* is the dehydration of the product. In storage plants which use blast systems the product tends to dehydrate with greater rapidity than in plants in which low temperatures are maintained in still air. Further, one of the greatest causes of dehydration is caused by "split," meaning the differential in temperature between the refrigerant and the storage room. Dehydration will be kept to a minimum if a split of no more than seven or eight degrees is maintained.

Finally, a brief word about the important subject of *sanitation* is necessary in any discussion of handling shrimp in the packing and freezing plant.

Care should be exercised to assure an unpolluted supply of water; plants should be adequately screened to protect the product from flies and other insects. Sanitary facilities should be available for all plant personnel. Hand washing facilities with liquid soap and paper towels should be supplied, and a chlorine bath for the hands would be valuable. Plant equipment should be thoroughly washed down before and after each use, and sanitized. Refuse should be properly disposed of, and not allowed to accumulate on the premises.

Lack of plant sanitation can destroy the effectiveness of quality control; sanitation and quality control go hand in hand in the most successful shrimp freezing plants. And finally, a word of caution to producers: freezing cannot enhance the quality of your product. Only by scrupulous attention to quality grading and control, and by control in the various points in processing, as well as in the sanitation of the plant, can a first class product be sent out which, year in and year out, will bring repeat business.

Handling Shrimp in the Breading Plant

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Since its inception just five years ago the breaded shrimp industry has become a multi-million dollar segment of the seafood business. This continuous expansion has been very similar to the amazing growth of frozen citrus concentrates. In both fields, the young but dynamic frozen foods industry has made these products available to the mass consumer market.

At present there must be well over a hundred different brands of breaded shrimp, and even though no accurate statistics are available, it has been

estimated that from 25 to 40 per cent of all shrimp production is now going through the breading plants. It is predicted that this ratio of shrimp used for primary processing will continue to increase. This has meant increased business—a "plus" market—for the shrimp industry. More than 200,000 frozen foods cabinets in retail grocery stores are regularly stocked with breaded shrimp. Millions of consumers have discovered the taste quality and the quick convenience of this delicious seafood. The net effect has been a constant rise in the overall demand for shrimp, and the pressure of this demand has accelerated the need for more production of fresh shrimp. The difference in supplies available and the current market requirements has caused the commodity value of shrimp on the waterfront to rise to higher levels than ever prevailed prior to 1953.

During these first years of our industry we have experienced consumer approval and market acceptance which in turn has made possible the rapid growth. On the other hand, the demand factor on a national basis has caused sharp increases in fresh shrimp prices; there has been keen competition by new processors for established trade outlets, and some other protein foods have declined in price. The fundamental premise of demand, however, is that the consumer did accept breaded shrimp, and that this acceptability was built on a quality factor.

Undoubtedly the present high raw shrimp prices could be drastically cut if the major producers of breaded shrimp suddenly flooded the market with inferior packs and destroyed much of the new consumer following, in turn lowering their need for large quantities for processing. The other route to market suicide was experienced early in 1953 when short supply caused unrealistically high prices, loss of sales to other foods, and losses by the processors who could not pass along all of the increase—or who couldn't find buyers for two-thirds breading and one-third shrimp.

It is not the intention here to discuss the broad economics of the total shrimp industry, but to describe briefly methods of handling shrimp in the processing plant in order to obtain a high quality product acceptable to the millions of families who constitute one vast consumer panel. However, since quality is inter-related to processing costs and selling prices, the plant operation is a most vital step from the ocean to the consumer's table. In determining processing policy the packer today must select one of two courses: How good a product, or how low a selling price? He cannot have both.

One partial answer to constantly increasing costs versus keen competition for markets has been found in plant mechanization. At the outset it was assumed that machinery would be developed to replace some of the hand labor of grading, cleaning, and breading shrimp, but no large manufacturer of food processing equipment showed any interest in developing such equipment. The result was that various packers created and built their own equipment, generally based on their own ideas and experience. Today, however, there is definite interest by some machinery manufacturers in carrying forward this work and improving the efficienecy of production in shrimp breading plants.

In this phase of our development we felt that it was mandatory for the machine to deliver as good or better a product than the quality possible by expensive hand labor. Shrimp quality begins at sea. Before it ever reaches the breading plant the shrimp must be properly handled on the boat, through

the packing houses, and during transportaiton as fresh iced seafood. A great deal of attention has been focused on these phases by the Shrimp Association of the Americas, the Marine Laboratory of the University of Miami, the processors, and others. Many plants like our own have found that having expert company buyers, or purchasing through highly reliable packing houses where responsibility can be definitely placed, are two safe ways to obtain the necessary ocean excellence required.

In describing plant handling, the steps outlined are of necessity those used by SeaPak, but I know from personal experience that other packers are also developing new and better in-plant methods in order to obtain the best possible quality.

We have found that certain axioms should be firmly impressed on all employees, so that there is some automatic response to offset the inevitable factors of human error or carelessness. These include such slogans as "Keep It Cold!", "Be Sure It Is Right Before It Leaves Your Department!", "If You Don't Know, Ask Your Supervisor—Don't Guess!", and similar truisms.

With the arrival of fresh shrimp from the packing houses, the first step is a quick inspection of the load for icing, count and condition, before it leaves the truck. Next the boxes are unloaded on a roller conveyor from the truck, through a canvas flap opening just large enough to accommodate the box. In the receiving room the shrimp and ice are poured into a de-icing vat with a water temperature under 40 degrees F. so they will not pick up heat from the washing water. A wide LaPorte chain conveyor moves the shrimp from the vat along an inspection section, where trained workers check the quality under adequate lights. Here also are separated any broken or crushed shrimp, heads, seaweed, or other foreign matter.

From the inspection belt the shrimp go into another belt conveyor which ascends to the top of a grading machine. A vibrating grooved table feeds the shrimp into the rapidly spinning sets of grading rolls which permits them to fall through into one of six chutes, for six sizes. Narrow white neoprene rubber conveyors move the shrimp from the grader into hanging scales which accumulate one hundred pounds of shrimp. From the scales, the shrimp are re-iced with Flak-Ice, and each one hundred pound box gets a receiving tag showing the count, lot number, and date received. A tally sheet is used to check the weight received against the shipper's weight.

After washing and de-icing, inspection, grading, and weighing, the shrimp are ready for immediate processing or holding in a cooler where the ice is allowed to melt gradually. At this point, the final end product is determined. This might be round or butterfly breaded shrimp, individually frozen peeled and deveined shrimp, cooked shrimp, or frozen shrimp. A batch number is assigned to each lot, and this batch record follows through all processing stages.

In the "Green Room" the shrimp are peeled and deveined by hand. From a table-height container holding approximately 200 pounds of shrimp, aluminum pans are loaded with about four pounds of shrimp packed with ice. These move down a conveyor to the worker's station, where the peeler places the pan over a galvanized trough of running water. The peeled shrimp go into an empty second pan and when all the shrimp are peeled and deveined from the first pan, the peeler places her numbered plastic tag on top and sends the pan down for inspection and weighing. The weight and the employee's number are entered on a tally sheet.

At each worker's peeling station there is a continuous jet of cold running water so that the shrimp can be peeled, cleaned and washed at the same time. The small quantity sent to each worker makes it possible to keep the shrimp cold during this stage, and also facilitates easy inspection.

Once again the cleaned shrimp go back into Flak-Ice and are ready for the breading process. This is one of the most crucial phases of processing, since it is essential that the batter be kept as cold as possible to retard bacterial action. Also, it is desirable that a uniform quantity of breading be added to the shrimp—neither too much nor too little. Speed is also very important since the shrimp will pick up processing room temperature very rapidly, and the sooner the product gets into the freezer, the better.

While methods of applying breading differ in various plants, a large percentage of breaded shrimp has been improperly handled, and its quality damaged during the breading operation, primarily due to lack of temperature control in the batter or shrimp. As the temperature rises in shrimp there is a rapid increase in autolysis and bacterial decomposition which progressively destroys the value of the seafood.

After packing in the retail or institutional pack, it is imperative that the packages be moved into the freezing cycle as soon as possible. Shrimp contain about 79 per cent water, and during slow freezing much of the contained water escapes from the cells and forms ice crystals. This phenomenon is accompanied by a rupturing of cell structures, rapid autolysis, and loss of juices on defrosting. Freezing shonld therefore be accomplished in the shortest possible time.

Our particular solution to this problem is to freeze shrimp individually before packing, rather than packing first and freezing afterwards. Although the system is more expensive than the customary package freezing method, we believe that the end justified the means. The "end" in this case is a premium price.

As the business of breaded shrimp has constantly increased the consumer has actually become more expert in judging the quality of a particular package, based on experience either with that brand or a new brand she is trying. Before his products even reach distribution channels, the packer can make his own careful examination of the day-to-day output by having a modern test kitchen and a trained home economist. The entire annual cost of this department might be less than the direct loss in business or good will from just one hour's run of off-quality shrimp. Immediate kitchen testing will show variations from standards so that they can be immediately corrected in the plant. The same holds true with the invisible factors affecting the end product which cannot be evaluated without scientific knowledge and instruments. These include bacterial determinations, examination of supplies, and the various other routine duties of the food technologist.

Efficient production by itself, even with high quality fresh shrimp, does not necessarily result in good quality. The factors of plant and employee sanitation are probably more vital to shrimp processing than any other type of food in the avoidance of contamination. Many volumes have been published on this subject, and assistance is available from local, state and federal health departments. Whenever these accepted standards are not complied with, the breaded shrimp industry is damaged in the long run, for quality inevitably suffers.

After processing and freezing, the packer must maintain the finished products in continuous sub-zero storage, using a non-fluctuating temperature with sufficient air channels for cold circulation. In shipping to wholesalers or storage warehouses every precaution should be taken to avoid a temperature rise at any point in the chain of distribution to the ultimate consumer.

To sum up, remember the following: 1. That quality in any shrimp product can be no better after processing than before: *buy for quality.* 2. That prime quality in fresh shrimp is a characteristic which is lessened each hour the product remains unfrozen, however much care is taken of the product and however small may be such change in the initial period of holding — even under ideal conditions: *complete the processing in the shortest possible time.* 3. That plenty of melting ice is essential to proper holding, no matter how low a holding temperature may be possible. Don't spare the ice and see that it melts at a satisfactory rate. 4. That cold is a protector of quality, an insulator against the normal warm air of the processing room. Surround the product with this protection through all steps of processing. 5. That the lower the temperatures can be held at all points in the processing cycle, the less harmful bacterial action there will be, and the quicker the product can be frozen when it reaches the freezer. In particular, keep batter well under fifty degrees F. in the breading step. 6. That to protect the ocean-goodness characteristics of fresh shrimp, freeze it quickly. 7. That cleanliness of all equipment, pans, etc., which come into contact with the product at any stage is vital. Harmful bacteria are ever-present and will soon be out of control if not checked by adequate cleaning and sanitation methods: institute proper equipment-sanitizing methods. 8. That cleanliness of all persons handling the product is equally or even more essential than that of equipment. Have your plant personnel made aware of the importance of cleanliness in the operation. Provide for regular health checks. Provide for sterilization of hands on entry or re-entry to the processing room.

Finally, remember that consistent high quality is not easily achieved nor is the cost low, but a business and an industry can grow with quality as a partner, but not well without it. Beautiful labels, wonderful advertising programs can help mightily to sell the consumer her first package of breaded shrimp, but what quality she finds *in* the package will determine not only how soon she will buy another package but also *if* she will ever buy another package.

Handling Shrimp In the Canning Plant

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In this country the Dunbar family began the canning of shrimp in 1867. The early problems were mainly concerned with finding a suitable container for use in preserving the shrimp. The growth of shrimp canning was aided in large measure by the advances in can manufacture and can sealing equipment. One of the first problems encountered was to prevent black discoloration caused by iron sulphide. Thanks to the development of an enamel for use on the interior of the cans it is no longer necessary to sew the shrimp